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ABSTRACT

In this instructional guide, a third-level, two-semester mathematics course specifically for the student who plans a career in a vocational field is presented. The course is designed to meet the needs of students with varying mathematical backgrounds and to teach the mathematical skills required by various technical areas. In this practical approach, instruction in understanding concepts is followed immediately by instruction in how to apply the concepts in real workday situations. The course includes instruction in the following areas: solving problems with a calculator; linear measurement including the English system, the metric system, and common and decimal fractions; measurement of capacity, mass and temperature; basic algebra; ratio, proportion and percent; graphs and tables; geometry; measurement of area and volume; and money and time. Included in the guide are: (1) a course outline; (2) a master list of competencies; (3) a master list of performance objectives; (4) equipment lists; (5) a list of suggested computer software; (6) instructional activities for each of the 64 competencies; and (7) applications for each of the 85 performance objectives. Representative competencies include: find the perimeter of polygons using English units; convert decimals to common fractions and vice versa; explain and use tolerance; evaluate expressions with powers and roots; read and interpret line, bar and circle graphs; read trigonometric tables; identify quadrilaterals; find the area of a triangle, parallelogram, or circle; computer salaries; complete invoices. Among the performance objectives are such exercises as: given any combination of decimal numbers, perform any of the four basic math operations; given a container and specified metric unit, determine its mass to the nearest half unit; given an expression with an exponent or radical, write its value without an exponent or radical; and given a table, interpolate to find a value between two given values. (CW)

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SOUTH CAROLINA GUIDE

FOR

MATHEMATICS FOR THE TECHNOLOGIES
(APPLIED VOCATIONAL MATHEMATICS)

PREPARED BY

SOUTH CAROLINA DEPARTMENT OF EDUCATION

OFFICE OF VOCATIONAL EDUCATION

COLUMBIA, SOUTH CAROLINA

IN COOPERATION WITH

THE DEPARTMENT OF INDUSTRIAL EDUCATION

CLEMSON UNIVERSITY

CLEMSON, SOUTH CAROLINA

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FOR

MATHEMATICS FOR THE TECHNOLOGIES

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PREFACE

Mathematics For The Technologies is based on the premise that mathematics is not a discipline that can be transferred to students solely through conditioning. It is, rather, a discipline which requires exploration. This exploration can be exciting, unpredictable, mysterious, complex, and creative! Ideally, students who successfully complete the course will agree with George Cantor when he declared: "The essence of mathematics is its freedom".

COURSE DESCRIPTION AND SUGGESTIONS

Mathematics For The Technologies has been designed as a third level, two semester mathematics course specifically for the student who plans a career in a vocational field. The course is a conscious effort to meet the needs of students with varying degrees of mathematical backgrounds and to teach the mathematical skills required by the various technical areas. The approach is practical rather than academic, and understanding of concepts is followed by the application of concepts in real workday situations.

The course will include instruction in the following areas: using the calculator, linear measurement, measurement of capacity, mass and temperature, basic algebra, ratio, proportion and percent, graphs and tables, geometry, measurement of area and volume, money, and time.

The teacher may use one or more of a variety of instructional delivery techniques to deliver the content but it is strongly suggested that the equipment and computer resources listed in the Appendix be used to provide as much realistic student centered, hands-on instruction as possible. Without this hands-on practical approach to instruction the learning enhancement intended by this guide may not be achieved.

It is suggested that the teacher use a pretest before each major unit of instruction to determine areas where extra emphasis may be needed.

SUGGESTED ENTRY AND EXIT CRITERIA

Entry

In order to facilitate success in this course, the following criteria might be used in assigning students to the course.

1. The student should have passed the SCBSAP Math Exit Exam.
2. The student should have the recommendation of the previous math teacher.
3. The student should have earned 2 or more math credits.

Exit

After considering minimum exit competencies, it is recommended that the entire listing of course competencies be used as minimum exit requirements.

COURSE OUTLINE

- I. Solving Problems With a Calculator
  - A. Estimation
    - 1. Place Value
    - 2. Rounding
    - 3. Estimating sums, differences, products, and quotients
  - B. Solving Problems by Adding Whole Numbers
  - C. Solving Problems by Subtracting Whole Numbers
  - D. Solving Problems by Multiplying Whole Numbers
  - E. Solving Problems by Dividing Whole Numbers
  - F. Solving Sum, Difference, Product and Quotient Whole Number Problems
- II. Linear Measurement
  - A. English System
    - 1. Reading a ruler
    - 2. Common fractions
      - a. meaning
      - b. comparison
      - c. equivalent
      - d. operations
    - 3. Converting within customary system
    - 4. Perimeter
  - B. Metric System
    - 1. Reading a ruler
    - 2. Decimal fractions
      - a. meaning, reading, writing
      - b. comparison

        - c. converting to common fractions and vice versa
        - d. operations
    - 3. Converting within metric system
    - 4. Perimeter
  - C. Tolerance
  - D. Reading Micrometers
- III. Measurement -- Capacity, Mass, Temperature
  - A. Measuring Capacity With English Units
  - B. Measuring Capacity With Metric Units
  - C. Measuring Mass With English Units
  - D. Measuring Mass With Metric Units
  - E. Reading Fahrenheit and Celsius Thermometers
- IV. Introduction to Basic Algebra
  - A. Signed Numbers
  - B. Applying the Proper Order of Operations to Solve a Formula
  - C. Applying the Rules for Solving for Any Variable in a Formula
  - D. Solving Formulas
  - E. Powers and Roots (Exponents and Radicals)
  - F. Scientific Notation
- V. Ratio, Proportion and Percent
  - A. Simplifying Ratios
  - B. Writing and Solving Proportions
  - C. Scale Drawings
  - D. Changing Percent to Decimals or Common Fractions and Vice Versa
  - E. Solving Percent Problems

VI. Graphs and Tables

- A. Locating Points in a Coordinate Plane
- B. Reading Tables
- C. Interpolation
- D. Reading and Interpreting Line, Bar and Circle Graphs

VII. Geometry

- A. Lines
  - 1. Perpendicular
  - 2. Parallel
- B. Angles
  - 1. Classifying angles
  - 2. Identifying pairs
  - 3. Measuring
  - 4. Drawing
- C. Triangles
  - 1. Classify
  - 2. Identify parts
  - 3. Sum of angles
  - 4. Similar
  - 5. Trigonometry
    - a. reading trigonometry tables
    - b. sine, cosine, tangent functions
    - c. solving problems
- D. Quadrilaterals
  - 1. Identification
  - 2. Characteristics

- E. Circles
    - 1. Parts
    - 2. Characteristics
    - 3. Circumference

VIII. Measurement -- Area and Volume

- A. Area of Triangles, Parallelograms, Circles
- B. Area of Irregular Figures
- C. Surface Area of Rectangular Solids and Cylinders
- D. Volume of Rectangular Solids and Cylinders

IX. Money and Time

- A. Computing Salaries
- B. Completing Invoices

Master List
of
COMPETENCIES

The student is required to demonstrate mastery of the following competencies in order to complete successfully the course in Mathematics For The Technologies.

Course Outline		Competencies
IA	1.	Determine place value to hundred thousands.
IA	2.	Round whole numbers to a designated place value.
IB	3.	Estimate sums, differences, products and quotients.
IB-F	4.	Solve problems that require computations with whole numbers.
IB-F	5.	Use a calculator to solve problems.
IIA	6.	Read an English-unit ruler.
IIA	7.	Explain the meaning of common fractions.
IIA	8.	Compare fractions.
IIA	9.	Give equivalent fractions.
IIA	10.	Add, subtract, multiply and divide fractions.
IIA	11.	Make conversions within the English system of measurement.
IIA	12.	Find the perimeter of polygons using English units.
IIB	13.	Read a metric ruler.
IIB	14.	Read and write decimals.
IIB	15.	Compare decimals.
IIB	16.	Convert decimals to common fractions and vice versa.
IIB	17.	Add, subtract, multiply, divide and round decimals to a designated place value.
IIB	18.	Make conversions within the metric system.

IIB	19.	Find the perimeter of a polygon using metric units.
IIC	20.	Explain and use tolerance.
IID	21.	Read metric and English micrometers.
IIIA	22.	Measure capacity with English units.
IIIB	23.	Measure capacity with metric units.
IIIC	24.	Measure mass with English units.
IIID	25.	Measure mass with metric units.
IIIA-D	26.	Make conversions within systems among capacity units and among mass units.
IIIE	27.	Read Fahrenheit and Celsius thermometers.
IVA	28.	Explain meaning of signed numbers.
IVB	29.	Apply the proper order of operations to solve a formula.
IVC	30.	Apply the rules for solving for any variable in a formula.
IVD	31.	Solve formulas.
IVE	32.	Evaluate expressions with powers and roots.
IVF	33.	Read and write numbers in scientific notation.
VA	34.	Write and simplify ratios.
VB	35.	Write and solve proportions.
VC	36.	Interpret and use scale drawings.
VD	37.	Write equivalent forms of percents, decimals and common fractions.
VE	38.	Solve percent problems.
VIA	39.	Locate points in a coordinate plane.
VIB	40.	Read information from a table.
VIC	41.	Interpolate to find information missing from a table.
VID	42.	Read and interpret line, bar and circle graphs.

VIIA	43.	Identify perpendicular lines.
VIIA	44.	Identify parallel lines.
VIIA	45.	Tell relationships of angles formed by perpendicular and parallel lines.
VIIB	46.	Classify angles according to their measures.
VIIB	47.	Identify angle pairs and state relationships regarding angle measures.
VIIB	48.	Measure angles.
VIIB	49.	Draw angles.
VIIC	50.	Classify triangles according to the length of their sides and the measure of their angles.
VIIC	51.	Identify the parts of triangles, including construction of medians, altitudes and angle bisectors.
VIIC	52.	Find missing angle of a triangle.
VIIC	53.	Identify similar triangles and find the missing side.
VIIC	54.	Read trigonometric tables.
VIIC	55.	Use sine, cosine and tangent functions.
VIID	56.	Identify quadrilaterals.
VIIE	57.	Identify the parts of a circle and tell the characteristics.
VIIE	58.	Find the circumference of a circle.
VIIIA	59.	Find the area of a triangle, parallelogram or a circle.
VIIIB	60.	Find the area of irregular figures.
VIIIC	61.	Find the surface area of rectangular solids and cylinders.
VIIID	62.	Find the volume of rectangular solids and cylinders.
IXA	63.	Compute salaries.
IXB	64.	Complete invoices.

Master List
of
PERFORMANCE OBJECTIVES

The student is required to perform successfully the following objectives in order to demonstrate mastery of the competencies upon which Mathematics For The Technologies is based. A suggested guideline to follow in measuring mastery is 75% accuracy in the completion of the section labeled EVALUATION located at the close of each lesson.

Course Outline		Performance Objectives
IA	1.	Given a six-digit whole number, state the place value of each digit.
IA	2.	Given a six-place whole number, round the number to a designated place value.
IA	3.	Given two four-digit numbers, estimate the sum and difference to the nearest hundred.
IA	4.	Given a three-digit number and a one-digit number, estimate the product and quotient to the nearest ten or hundred.
IB	5.	Given a calculator, solve application problems that require adding whole numbers.
IC	6.	Given a calculator, solve application problems that require subtracting whole numbers.
ID	7.	Given a calculator, solve application problems that require multiplying whole numbers.
IE	8.	Given a calculator, solve application problems that require dividing whole numbers.
IF	9.	Given a calculator, solve application problems involving all four basic operations with whole numbers.
IIA	10.	Given a line segment and a ruler, measure the length of the segment to the nearest sixteenth of an inch.
IIA	11.	Given a common fraction, draw a pictorial representation.
IIA	12.	Given two common fractions, tell which is larger, or state that they are equivalent.

IIA 13. Given a common fraction and a new denominator, write an equivalent fraction.

IIA 14. Given any combination of fractions, mixed numbers and whole numbers, find the sum.

IIA 15. Given any combination of fractions, mixed numbers and whole numbers, find the difference.

IIA 16. Given any combination of fractions, mixed numbers and whole numbers, find the product.

IIA 17. Given any combination of fractions, mixed numbers and whole numbers, find the quotient.

IIA 18. Given any combination of fractions, mixed numbers and whole numbers, perform any of the four basic math operations.

IIA 19. Given a linear measure in the English units, write an equivalent measure in another unit.

IIA 20. Given a polygon with dimensions in English units, find the perimeter.

IIB 21. Given a line segment and a ruler, measure the length of the segment to the nearest millimeter.

IIB 22. Given a list of decimal fractions in numerical form and a list in word form, match equivalent forms.

IIB 23. Given two decimal fractions, tell which is larger, or state that they are equivalent forms.

IIB 24. Given a list of common fractions and a list of decimal fractions, match equivalent forms.

IIB 25. Given two decimal numbers, find the sum.

IIB 26. Given two decimal numbers, find the difference.

IIB 27. Given two decimal numbers, find the product and round to a designated place value.

IIB 28. Given two decimal numbers, find the quotient and round to a designated place value.

IIB 29. Given any combination of decimal numbers, perform any of the four basic math operations.

IIB 30. Given a linear measure in metric units, write an equivalent measure using a different unit.

IIB	31.	Given a polygon with dimensions in metric units, find the perimeter.
IIC	32.	Given a measurement in metric or English units and the tolerance, state the acceptable measures.
IID	33.	Given a metric or English micrometer and an object to be measured, measure the stated dimension to the nearest thousandth of an inch or hundredth of a millimeter.
IIIA	34.	Given a container and a specified English unit, determine the capacity to the nearest half-unit.
IIIB	35.	Given a container and specified metric unit, determine its mass to the nearest half-unit.
IIIC	36.	Given an item and a specified English unit, determine its mass to the nearest half-unit.
IIID	37.	Given an item and a specified metric unit, determine its mass to the nearest half-unit.
IIIA-D	38.	Given an English capacity or mass measurement, write an equivalent English measurement using a different unit.
IIIA-D	39.	Given a metric capacity or mass measurement, write an equivalent metric measurement using a different unit.
IIIE	40.	Given a Fahrenheit or Celsius thermometer, read the temperature to the nearest half-degree.
IVA	41.	Given a list of positive and negative numbers and a list of interpretations, match the number to the meaning.
IVB	42.	Given a formula for a variable and all other values, solve for the variable by applying the proper order of operations.
IVC	43.	Given a formula, solve for any variable in terms of the other variables in the formula.
IVD	44.	Given a formula and values for all but one variable, solve the formula to find the value of the remaining variable.
IVE	45.	Given an expression with an exponent or radical, write its value without an exponent or radical.

IVF	46.	Given a list of numbers written in scientific notation and a list of numbers in expanded form, match the scientific notation expression with its expanded form.
VA	47.	Given a verbal statement containing a ratio, write the ratio in numerical form and simplify it.
VB	48.	Given a verbal problem, write a proportion to solve the problem.
VB	49.	Given a proportion with one unknown, solve the proportion.
VC	50.	Given a scale drawing, write and solve a proportion to find unknown lengths.
VD	51.	Given a percent, write the equivalent common fraction and decimal.
VD	52.	Given a decimal, write the equivalent common fraction and percent.
VD	53.	Given a common fraction, write the equivalent percent and decimal fraction.
VE	54.	Given a percent problem, find the missing rate, base or part.
VIA	55.	Given a list of ordered pairs and a set of points in a coordinate place, match one set of ordered pairs to the points.
VIB	56.	Given a table, answer questions pertaining to the information in the table.
VIC	57.	Given a table, interpolate to find a value between two given values.
VID	58.	Given a line graph, answer questions pertaining to the information in the graph.
VID	59.	Given a bar graph, answer questions pertaining to the information in the graph.
VID	60.	Given a circle graph, answer questions pertaining to the information in the graph.
VIIA	61.	Given pairs of parallel and perpendicular lines, identify each.

VIIA	62.	Given a pair of parallel lines cut by a transversal and the measure of one angle which is formed, find the measures of the other seven angles.
VIIB	63.	Given an angle (drawing or measure), classify it as acute, obtuse, straight or right.
VIIB	64.	Given drawings of supplementary, complementary, vertical and adjacent angles, identify each pair of angles.
VIIB	65.	Given the measure of one angle in a pair of supplementary, complementary or vertical angles, find the measure of the other angle.
VIIB	66.	Given an angle and a protractor, find the measure of the angle to the nearest half-degree.
VIIB	67.	Given a protractor, draw an angle of given measure correct to the nearest half-degree.
VIIB	68.	Given a triangle, classify it as acute, obtuse, right, scalene, isosceles, or equilateral.
VIIC	69.	Given a triangle, construct the medians, altitudes and angle bisectors.
VIIC	70.	Given a right triangle, identify the legs and hypotenuse.
VIIC	71.	Given the measures of two angles of a triangle, find the measure of the third angle.
VIIC	72.	Given two triangles, tell whether or not they are similar.
VIIC	73.	Given two similar triangles and the ratio of the lengths of the sides, find the length of the missing side.
VIIC	74.	Given a table of trigonometric values, answer questions pertaining to the table.
VIIC	75.	Given a right triangle, write the sine, cosine and tangent ratios.
VIIC	76.	Given right triangles, use the sine, cosine and tangent functions to find missing sides and angles.
VIID	77.	Given a set of quadrilaterals, identify each as a parallelogram, square, rectangle, rhombus or trapezoid.

VIIE 78. Given a circle, identify radius, diameter, chords, arcs, central angle and inscribed angle.

VIIE 79. Given a circle and the measure of its radius or diameter, find the circumference.

VIIIA 80. Given a triangle, parallelogram, or circle, and the necessary measurements, compute the area.

VIIIB 81. Given an irregular polygon and necessary measurements, subdivide the polygon and compute the area.

VIIIC 82. Given a rectangular solid or cylinder and the necessary measurements, find the surface area.

VIIID 83. Given a rectangular solid or cylinder and one necessary measurement, find the volume.

IXA 84. Given a rate of pay, compute a salary for a given pay period.

IXB 85. Given an invoice form and the necessary rates and prices, complete the invoice to determine a price estimate or exact cost.

Trade and Industrial Education Equipment List

Major Mathematics for the Technologies

REVISION DATE: January 1, 1990

The equipment list on this form is the recommended equipment guide for the program of study listed above.

When a school district request approval of equipment, the request should be the same as the item number listed along with the description of the item. A cross reference will be made based on the requests from school districts. Items not on the list will be eliminated from the local request. Exceptions may be made on unique local needs. All equipment must meet Occupational Safety and Health Act Regulations.

ITEM NO.	QUANTITY	ITEM	SPECIFICATIONS	ESTIMATED UNIT COST	ESTIMATED TOTAL COST
1	2	Computer	640K Ram, dual disk drive, with math co-processor and clock calendar with battery back-up	1,000.00	2,000.00
2	1	Storage Cabinet	Metal double door cabinet with adjustable shelves	184.00	184.00
3	1	Overhead Projector	10" x 10" area, fan operated cooling	235.00	235.00
4	1	Projector Cart	Two level surfaces with storage drawer	228.00	228.00
5	5	Calculator	8 digit, solar scientific powered calculator	120.00	600.00
				TOTAL	$3,247.00

Supplemental Equipment List

Mathematics for the Technologies Program

REVISION DATE: January 1, 1990

The following are tools and supplies costing less than $100.00. These items are needed for the development of knowledge and skills in Mathematics for the Technologies. It is the responsibility of the local education agencies to secure these items of equipment through local resources.

ITEM NO.	QUANTITY	ITEM	SPECIFICATIONS	ESTIMATED UNIT COST	ESTIMATED TOTAL COST
1	20	Machinists Rule	Stainless steel. Divided in sixteenth and thirty seconds	4.00	80.00
2	10	Line Level	With hooks that allow the level to slide freely	4.00	40.00
3	10	Measuring Cup	clear plastic - 16 oz.	4.50	45.00
4	20	Meter Stick	Graduated in millimeters divisions and 1/8" on reverse side	3.00	60.00
5	10	Micrometer Caliper	Calibrated to read 0 to 25 mm in 0.01 mm divisions	26.00	260.00
6	10	Needle Nose Pliers	Side cutting 6"	7.50	75.00
7	10	Platform Spring Scale	5 kg capacity	25.00	250.00
8	10	Stopwatch	24 hr., 1/100 second, digital	30.00	300.00
9	20	Caliper, Vernier	For measuring inside and outside diameters in both English and metric units. Plastic	7.00	140.00

ITEM NO.	QUANTITY	ITEM	SPECIFICATIONS	ESTIMATED UNIT COST	ESTIMATED TOTAL COST
10	10	Chalk Line	Chalk line reel and chalk set	6.50	65.00
11	10	Cloth Measuring Tape	60" long	2.00	20.00
12	20	Compass	Metal drawing compass w/pencil	1.00	20.00
13	5	Bucket	Five gallon polyethylene bucket	5.00	25.00
14	2	Extension Cord	12 ft. 3-way UL listed	12.00	24.00
15	1	Bathroom Scale	Graduated in lbs. division	31.00	31.00
16	1	Bathroom Scale	Graduated in KG. division	31.00	31.00
17	5	Basketball	Regulation size	18.00	90.00
18	10	Tire Pressure Gauge	Plastic	3.00	30.00
19	20	30-60 Degree Triangle	8" plastic	2.00	40.00
20	20	45 Degree Triangle	8" plastic	2.00	40.00
21	20	Rule	Combination architect and engineer rule	3.00	60.00
22	5	Thermometer	Outdoor (fahrenheit and celsius)	20.00	100.00
23	20	Protractor	Plastic	1.50	30.00

ITEM NO.	QUANTITY	ITEM	SPECIFICATIONS	ESTIMATED UNIT COST	ESTIMATED TOTAL COST
24	1	Chalkboard Drawing	T-square, straightedge, 30° - 60° triangle and protractor	45.00	45.00
25	1	Chalkboard Compass	17"	11.00	11.00
				Total	$1,912.00

Suggested Computer Software:

1. Testmaking Series on whole numbers, percents, fractions, numeration, and geometry - MAC Ware, P. O. Box 27, Chillicothe, OH 45601.
2. Equation Math and Coordinate Math -MESC
3. Plane Facts About Geometry - Sunburst
4. BLS - Tutor Program, Fractions
5. Rocky's Boots
6. Golf Clinic - Milliken
7. Lemonaide Stand
8. Grade Book
9. Grade Book Plus
10. Quiz-Master, Teaching Assistant
11. Math Bingo, Metric Master, Math Race - MAC Ware

Suggested Text and References:

This guide contains text references to the state adopted textbook, CAREER MATHEMATICS, Houghton Mifflin Company.

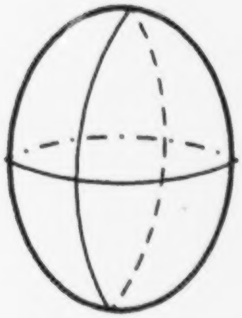
In addition, the following volumes of practical problems in mathematics by Delmar Publishing are highly recommended as resources:

1. Automotive Technicians
2. Carpenters
3. Consumers
4. Electricians
5. Electronic Technicians
6. Graphic Arts
7. Heating & Cooling
8. Machinists
9. Masons
10. Mechanical Drafting
11. Office Workers
12. Printers
13. Sheet Metal Technicians

Request Instructor's Guide.

section I

solving problems with a calculator



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #1

Determine place value to hundred thousands.

PERFORMANCE OBJECTIVE #1

Given a six-digit whole number, state the place value of each digit.

INSTRUCTIONAL ACTIVITIES:

Sample Items

1. Which digit is in the thousands place? 46,723 (ans: 6)
2. In this number, 2 is in what place? 123,456 (ans: ten thousands)

Notes

General: Students need to be able to read numbers correctly as well as state place value.

Activity: Have the students write numbers as the teacher reads them aloud. For example, if the teacher reads nine thousand, seven hundred six, the student would write 9,706.

Masonry: Brick masons use numbers up to about 50,000. The numbers could refer to bricks, area, length, money, or measurements for mortar.

Air Conditioning/Refrigeration: Whole numbers are needed so that students can compute and state values up to hundreds of thousands. Examples are:

1. Reading an ohmmeter with a scale of 100K. If meter indicates 8.25, then 8.25 x 100K or 825,000 ohms.
2. Air movement is measured in units of cubic feet per minute per ton of air conditioning. 400CFM/Ton x 40Tons = 16,000 CFM.
3. Heat energy is measured in British Thermal Units (BTU). Heat loss from a building would be stated 528,295 BTU.

REFERENCE TO TEXT

None

EVALUATION

1. In what place is the digit 3 in each of these numbers?
   a) 314,785
   b) 654,321

2. Which digit is in the thousands place?
   783,961

3. Which digit is in the tens place?
   458,762

ANSWERS TO EVALUATION

1. a) hundred thousands
   b) hundreds
2. 3
3. 6

ANSWERS TO APPLICATIONS

1. a) eighteen thousand BTU
   b) fifteen thousand, five hundred BTU
   c) sixty-one thousand, three hundred ninety-two BTU
   d) nine hundred eighty-three thousand, four hundred sixty-eight BTU

2. a) fourteen thousand, three hundred twenty-eight BTU
   b) twenty-nine thousand, six hundred forty-two BTU
   c) one hundred eight thousand, six hundred forty-nine BTU

3. a) twenty-four ohms
   b) thirty-three thousand, three hundred ohms
   c) fifty-seven thousand, one hundred twenty-six ohms
   d) nine hundred thirty-two thousand, one hundred sixty-nine ohms

4. a) 415 CFM
   b) 164,600 CFM
   c) 80,002 CFM
   d) 906,428 CFM

5.

$$\begin{array}{r} 2,425 \\ 663 \\ \underline{9,811} \\ 12,899 \end{array}$$

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #1

Performance Objective #1: Given a six-digit whole number, state the place value of each digit.

1. Air conditioning units are rated by the amount of heat energy that can be removed each hour. Read the following rates.
   a) 18,000 BTU
   b) 15,500 BTU
   c) 61,392 BTU
   d) 983,468 BTU

2. Heat energy is lost from a building when the outside temperature is less than the inside temperature. Read the following BTU losses.
   a) 14,328 BTU
   b) 29,642 BTU
   c) 108,649 BTU

3. An ohmmeter is used to measure the value of resistance which is measured in ohms. Read the following resistances.
   a) 24 ohms
   b) 33,300 ohms
   c) 57,126 ohms
   d) 932,169 ohms

4. The volume of air moved by a fan is measured in cubic feet per minute (CFM). Write the following numbers in figures.
   a) Four hundred fifteen CFM
   b) One hundred sixty-four thousand, six hundred CFM
   c) Eighty thousand, two CFM
   d) Nine hundred six thousand, four hundred twenty-eight CFM

5. Add the following numbers. (HINT: Write the numbers out as whole numbers first.) Two thousand, four hundred twenty-five plus six hundred sixty-three plus nine thousand, eight hundred eleven.

COMPETENCY #2

Round whole numbers to a designated place value.

PERFORMANCE OBJECTIVE #2

Given a six-place whole number, round the number to a designated place value.

INSTRUCTIONAL ACTIVITIES

Sample Item

Round to the nearest thousand: 76,681 (ans: 77,000)

Notes

Rounding is used more with decimals than with whole numbers in vocational areas. Frequently whole numbers are rounded up to ensure proper quantities of materials and for price estimates. Rounding is also used frequently when referring to the capacity of equipment.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 353.

EVALUATION

1. Round to the nearest hundred.
   a) 76,513
   b) 5,981

2. Round to the nearest thousand.
   a) $46,715
   b) $84,593

ANSWERS TO EVALUATION

1. a) 76,500
   b) 6,000

2. a) $47,000
   b) $85,000

ANSWERS TO APPLICATIONS

1.	Tens	Hundreds
a)	5,270 ft.	5,300 ft.
b)	89,420 ft.	89,400 ft.
c)	810 ft.	800 ft.
d)	33,150 ft.	33,200 ft.

2.	Thousands	Ten Thousands
a)	36,000	40,000
b)	145,000	140,000
c)	644,000	640,000
d)	888,000	890,000
e)	70,000	70,000
f)	166,000	170,000

3. a) $ 5,280
   b) $84,250
   c) $ 410
   d) $15,850

4. a) 125,600 bricks
   b) $413,800
   c) 213,600 sq. ft.

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #2

Performance Objective #2: Given a six-place whole number, round the number to a designated place value.

1. An electrician has computed requirements for electrical cable. Round the number to the place indicated.

			Round to the Nearest:	
	Size Cable	Quantity	Tens	Hundreds
a)	AWG 14	5,266 ft.		
b)	AWG 12	89,424 ft.		
c)	AWG 10	809 ft.		
d)	AWG 8	33,152 ft.		

2. An air conditioning contractor determined the heat energy lost from various rooms within a building. Round the number to the place indicated.

			Round to the Nearest:	
	Room	Quantity	Thousands	Ten Thousands
a)	Office A	36,285 BTU		
b)	Office B	144,598 BTU		
c)	Warehouse A	643,754 BTU		
d)	Warehouse B	888,023 BTU		
e)	Cafeteria	70,479 BTU		
f)	Equipment Room	165,902 BTU		

3. An inventory was taken of repair parts for cooling systems. Round the numbers to the nearest ten dollars.

a)	Coils	$ 5,284
b)	Compressors	$84,251
c)	Tubing	$ 408
d)	Motors	$15,846

4. Round the following numbers to the nearest hundred.

a) 125,635 bricks
b) $413,772
c) 213,550 square feet

COMPETENCY #3

Estimate sums, differences, products and quotients.

PERFORMANCE OBJECTIVE #3

Given two four-digit numbers, estimate the sum and difference to the nearest hundred.

INSTRUCTIONAL ACTIVITIES

Sample Items

1. The sum of 3,671 and 1,924 is closest to:
    a) 5,300
    b) 5,400
    c) 5,500
    d) 5,600
    e) 5,700
    (ans: d)

2. The difference of 3,671 and 1,924 is closest to:
    a) 1,600
    b) 1,700
    c) 1,800
    d) 1,900
    e) 2,000
    (ans: c)

Notes

When hand-held calculators are used, answers must be checked for reasonableness by using estimation skills. The teacher can aid in this process by asking questions such as: "Is the answer more or less than 500?" "Will one answer be closer to 1,000 or 1,500?" Estimation should also be used as part of solving word problems.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 38-44.

EVALUATION

1. The sum of 6,732 and 1,284 is closest to:
    a) 8,000
    b) 9,000
    c) 9,100
    d) 9,200

2. The difference of 6,732 and 1,284 is closest to:
   a) 4,400
   b) 5,400
   c) 5,500
   d) 5,600

3. Estimate this sum to the nearest hundred:
   3,514 + 4,625
   a) 8,000
   b) 8,100
   c) 8,200
   d) 8,300

4. Estimate this difference to the nearest hundred:
   4,625 - 3,514
   a) 900
   b) 1,000
   c) 1,100
   d) 1,200

ANSWERS TO EVALUATION

1. a
2. b
3. b
4. c

ANSWERS TO APPLICATIONS

1. a) 5,000
   b) 8,000
   c) 5,000

2. a) 3,300 oranges
   b) 1,100 oranges

3. 1,700 + 2,300 = 4,000 BTU

4. 2,500 + 1,000 = 3,500 CFM

5. 23,800 - 15,500 = 8,300 BTU

6. a) 135,800 - 133,000 = 2,800 BTU
   b) 151,300 - 135,000 = 15,500 BTU
   c) 146,900 - 143,200 = 3,700 BTU

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #3

Performance Objective #3: Given two four-digit numbers, estimate the sum and difference to the nearest hundred.

1. Circle the best estimate for the answer in each exercise.

   a) 1,532 + 3,418 = ?
   2,000 5,000 8,000

   b) 4,888 + 3,112 = ?
   6,000 7,000 8,000

   c) 3,012 + 2,101 = ?
   4,000 5,000 6,000

2. One worker picked 1,065 oranges and another worker picked 2,176 oranges.

   a) How many to the nearest hundred did they pick together?
   b) How many more to the nearest hundred did the second worker pick?

3. Heat gain calculations have been made on a house. One room has a gain of 1,672 British Thermal Units (BTU's) and another room has a gain of 2,309 BTU's. Estimate to the nearest hundred the total heat gain for the two rooms.

4. A fan is to be selected to move air in a two-story house. The first floor requires 2,469 cubic feet per minute (CFM) and the second floor requires 1,028 CFM. Estimate to the nearest hundred the total quantity of air that the fan must move.

5. Two window air conditioners are for sale. One is rated at 15,525 British Thermal Units per Hour (BTUH) and the other at 23,750 BTUH. Estimate to the nearest hundred the difference in the rating of the two air conditioners.

6. From the table listing the BTU ratings of fuel oil, estimate to the nearest hundred the difference in the heat per gallon.
   a) For No. 1 and No. 2 fuel oil
   b) For No. 2 and No. 6 fuel oil
   c) For No. 4 and No. 5 fuel oil

BTU Ratings of Fuel Oil

Grade	Heat/Per Gal.
No. 1	132,980
No. 2	135,830
No. 4	143,150
No. 5	146,860
No. 6	151,320

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #3

Estimate sums, differences, products and quotients.

PERFORMANCE OBJECTIVE #4

Given a three-digit number and a one-digit number, estimate the product and quotient to the nearest ten or hundred.

INSTRUCTIONAL ACTIVITIES

Sample Items

1) Estimate this product to the nearest 100.
365 x 8 (ans: 3,200)

2) Estimate this quotient to the nearest 10.
625 ÷ 7 (ans: 90)

Notes

General: See notes for Performance Objective #3. Remind students that to estimate answers, they should round first.

Air Conditioning/Refrigeration: Before selecting the size of heating unit, heat loss calculations must be made. This requires multiplication and division of whole numbers to the nearest hundred.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 38-44.

EVALUATION

1. Estimate to the nearest hundred: 591 x 4
   a) 2,000
   b) 2,100
   c) 2,400
   d) 2,500

2. Estimate to the nearest hundred: 226 x 6
   a) 1,200
   b) 1,300
   c) 1,800
   d) 2,000

3. Estimate to the nearest hundred: 415 ÷ 4
   a) 120
   b) 110
   c) 100
   d) 10

4. Which of the following is the best estimate to the nearest ten for 538 ÷ 6?
   a) 900
   b) 100
   c) 90
   d) 80

ANSWERS TO EVALUATION

1. c
2. a
3. c
4. c

ANSWERS TO APPLICATIONS

1. a) 600
   b) 2,500
   c) 400
   d) 200

2.

Windows		1,800 BTUH
Doors		600 BTUH
Net Wall		8,000 BTUH
Ceiling		5,600 BTUH
Floor		4,000 BTUH
Infiltration	W	400 BTUH
	D	900 BTUH

3. 200"

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #4

Performance Objective #4: Given a three-digit number and a one-digit number, estimate the product and quotient to the nearest ten or hundred.

1. Circle the best estimate for the answer in each exercise.
   a) 3 x 214 = ?

      400 500 600 700

   b) 5 x 498 = ?

      2,000 2,300 2,500 3,000

   c) 813 6 = ?

      200 300 400 500

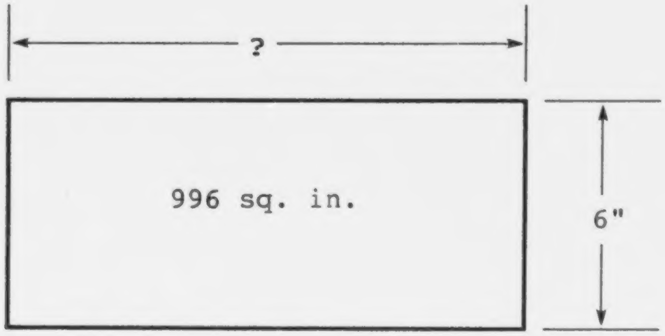
   d) 980 5 = ?

      100 200 300 400

2. To determine the BTUH (British Thermal Units per Hour) loss the area is multiplied by the Heat Transfer Factor (HTF). Estimate to the nearest hundred the BTUH loss of each area listed in the left column. Record your answer in the BTUH loss column.

	AREA	HTF	BTUH LOSS	
GROSS WALL	1239	XXXXX	XXXXXXXXX	
WINDOWS	158	9		
DOORS	109	6		
NET WALL	972	8		
CEILING	843	7		
FLOOR	843	5		
INFILTRATION W	147 lin. ft.			
D	111 lin. ft.			

3. A sheet of metal contains 996 square inches of area and one side is 6 inches. Estimate to the nearest hundred the length of the other side by dividing the area by the known side.



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCIES #4 & #5

Solve problems that require computations with whole numbers.Use a calculator to solve problems.

PERFORMANCE OBJECTIVE #5

Given a calculator, solve application problems that require adding whole numbers.

INSTRUCTIONAL ACTIVITIES

Sample Items

A plot of land is divided into 3 lots. The lots measure 12,278 square feet, 18,031 square feet and 14,956 square feet. What is the total area of the plot of land? (ans: 45,265 square feet)

Notes

Students entering trade and industry fields should be familiar with using hand-held calculators because they will encounter them in their work and personal lives. When working with whole numbers and decimals, students should be allowed and encouraged to use calculators. Remind students to check their answers for reasonableness by estimating first. Remind students to label their answers when working word problems.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 354.

EVALUATION

1. Jane's sales for the week were $4,276, $5,938 and $1,721. What were her total sales?

2. A truck is carrying 1,175 pounds of plate steel, 352 pounds of I-beams, and 2,285 pounds of iron. What is its total load?

3. A print shop operator printed 8,295 letterheads Monday; 13,670 on Tuesday; 6,918 on Wednesday and 3,720 on Thursday. How many letterheads did he print in the 4 days?

4. The following amounts of cable are used in an apartment house job: 372 meters, 578 meters, 56 meters and 825 meters. What is the total number of meters used?

ANSWERS TO EVALUATION

1. $11,935
2. 3,812 pounds
3. 32,603 letterheads
4. 1,831 meters

ANSWERS TO APPLICATIONS

1. $554
2. 5,106 bricks
3. $4,615
4. 88 hours
5. 12,854 + 4,656 + 6,298 + 6,616 + 3,324 + 4,266 + 3,528 + 6,136 + 420 = 48,098 BTUH

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #5

Performance Objective #5: Given a calculator, solve application problems that require adding whole numbers.

1. A contractor paid $347 for brick, $79 for block, $94 for mortar and $34 for sand. What was his total bill?

2. Five bricklayers working on a house each laid the following number of bricks in one day: 1st bricklayer, 895 bricks; 2nd bricklayer, 1,035 bricks; 3rd bricklayer, 947 bricks; 4th bricklayer, 1,211 bricks; 5th bricklayer, 1,918 bricks. What was the total number of bricks laid that day?

3. In preparing a bid on a job, a masonry contractor allowed $1,400 for materials, $1,115 for excavating and pouring footings, and $2,100 for labor. What was the total of his bid?

4. A crew of ten workers worked 18 hours, 30 hours and 40 hours. What was the total number of hours worked?

5. On the heating data sheet on the following page, determine the BTUH loss for each area of the house (i.e., L.R., B.R. #1, etc.), item 13, then the total BTUH loss for the entire house.

HEATING DATA SHEET

HEATING CONTRACTOR ____________________

NAME OF JOB ____________________

DATE ________ BY ________

OUTSIDE DESIGN TEMP. -2° F

INSIDE DESIGN TEMP 70° F

DESIGN TEMP. DIFF. 72° F

1 Room Use and Floor Level				1 L.R.		2 B.R.#1		3 BR#2		4 BR#3		5 Bath ½B		6 Utility		7 Kitchen		8 D.K.	
2 Room Length and Width				18X16		12X13		14X13		14X14		8X14		8X14		8X14		10X14	
3 Running Ft. of Exposed Wall				34		12		27		28		8		8		8		24	
4 Ceiling Height				8		8		8		8		8		8		8		8	
5 Exposure Type	Table No	"U" Factor	Multi-plier	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss
6 Gross Exposed Wall				272		96		216		224		64		64		64		192	
7 Windows and Doors W			40	79	3160	18	720	18	720	18	72	12	480	0		16	640	36	1440
D			22	21	462									21	462				
8 Net Exposed Wall			10	221	2110	78	780	198	1980	260	2600	52	520	43	430	48	480	156	1560
9 Cold Partition																			
10 Cold Ceiling			7	288	2016	156	1092	182	1274	196	1372	112	784	112	784	112	784	140	980
11 Cold Floor			10	288	2880	156	1560	182	1820	196	1960	112	1120	112	1120	112	1120	140	1400
12 Infiltration, (leakage) or Air Change			42	18	756	12	504	12	504	12	504	10	420	0		12	504	18	756
			70	21	1470									21	1470				
13 Room Sub-Total Btuh																			

Addition of these answers is total BTUH loss.

COMPETENCIES #4 & #5

Solve problems that require computations with whole numbers. Use a calculator to solve problems.

PERFORMANCE OBJECTIVE #6

Given a calculator, solve application problems that require subtracting whole numbers.

INSTRUCTIONAL ACTIVITIES

Sample Items

James laid 920 bricks today. John laid 684. How many more bricks did James lay? (ans: 236)

Notes

Air Conditioning/Refrigeration: When sizing duct for a forced air heating or cooling system, the student must be able to determine how much air is passing through the duct at any given point. To practice this procedure, the student is given a number, subtracts a quantity, records the remainder and continues to subtract additional values from each remainder.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 354.

EVALUATION

1. Lewis must lay 900 bricks before quitting time. He has laid 642. How many more must he do?

2. To get a commission William must sell $4,200 worth of printing a week. So far he has sold $2,867. How much more must he sell to start making a commission?

3. A 500-foot roll of wire is used in a house. So far strips have been cut that were 74 feet, 55 feet and 49 feet. How much wire is left?

4. A power supply is designed to produce 525 volts. It is set to 279 volts. How many more volts can it produce?

ANSWERS TO EVALUATION

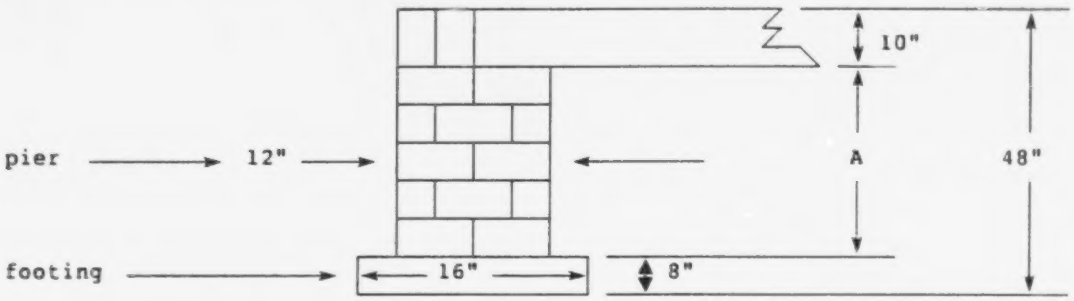
1. 258 bricks
2. $1,333
3. 322 feet
4. 246 volts

ANSWERS TO APPLICATIONS

1. 30"
2. 4"
3. $347
4. 24'
5. 19'
6. 9'1"
7. After A: 12,659 CFM
   After B: 10,517 CFM
   After C: 8,575 CFM
   After D: 4,346 CFM
   After E: 2,000 CFM
   After F: 2,000 CFM

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #6

Performance Objective #6: Given a calculator, solve application problems that require subtracting whole numbers.

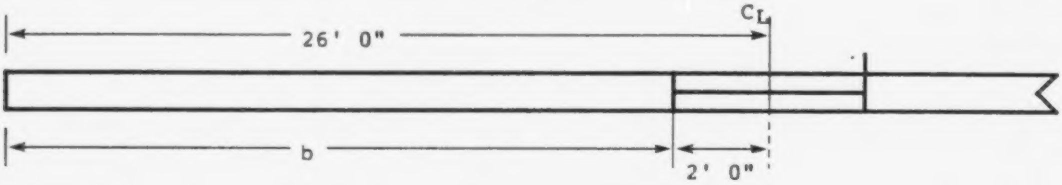


1. Using the drawing above, what is the dimension "A"?

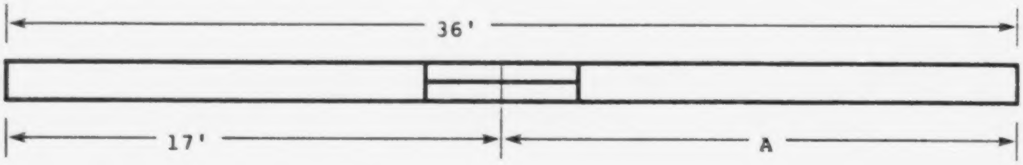
2. How much wider is the footing than the pier?

3. A bricklayer contracted a job for $1,150. A total of $447 was spent for brick, $92 for mortar and $34 for sand. If labor cost $230, what was the profit?

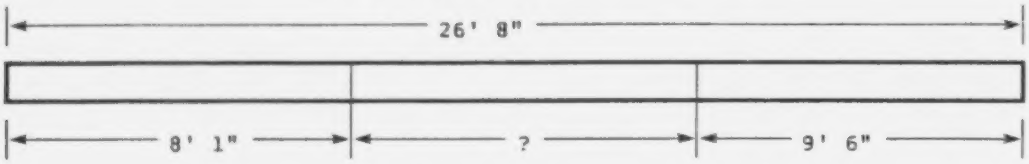
4. On floor plans the openings in wood frame walls are measured from a given point to the center (C_L) of the openings. If the carpenter needs to know the distance from the edge of the opening, he must subtract. Determine the missing dimension "B" in the sketch below.



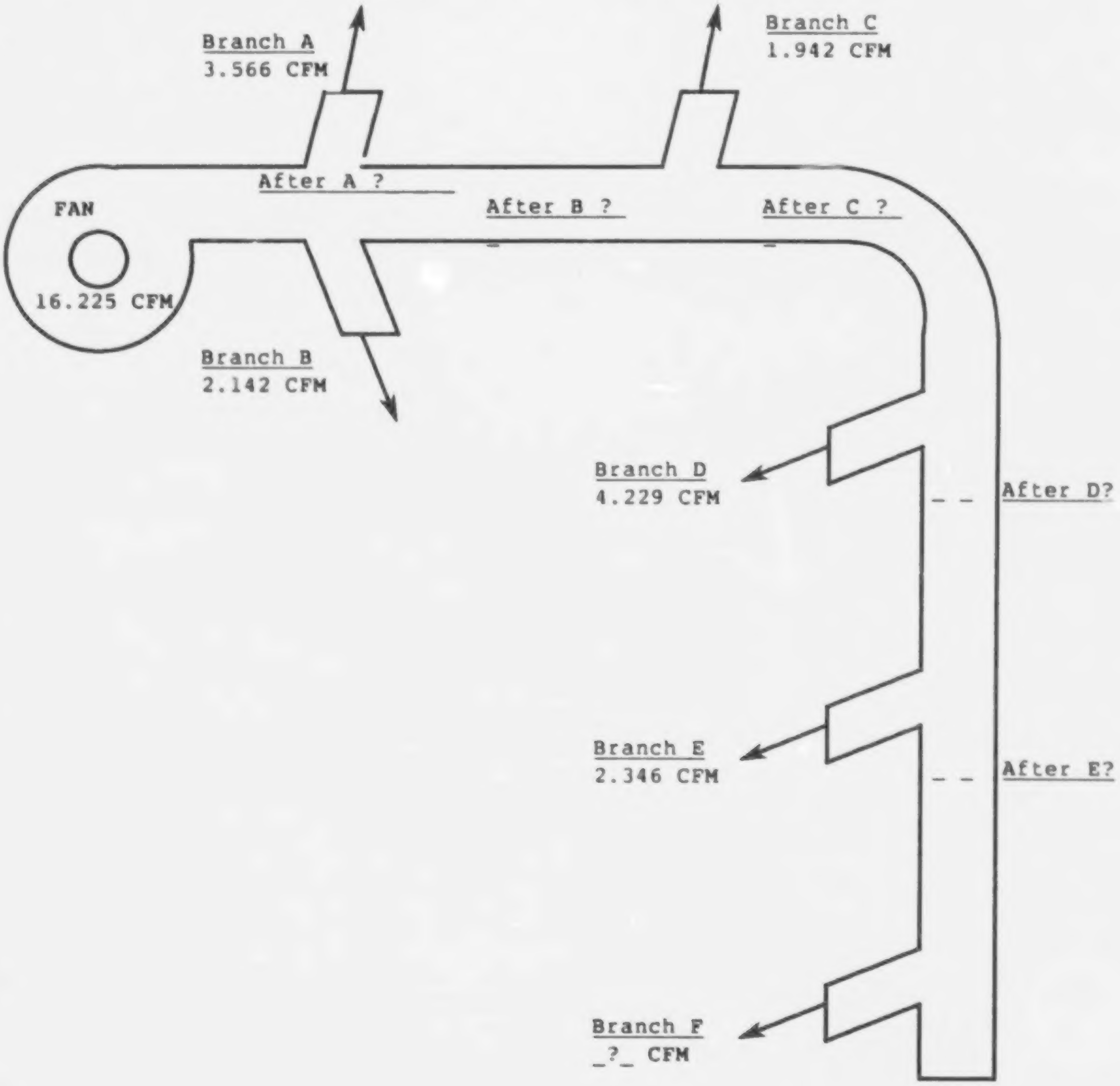
5. Determine the missing dimension.



6. Determine the missing dimension.



7. An air conditioning duct system has 16,225 cubic feet per minute (CFM) of air entering the main duct from the fan. A quantity of air leaves the main duct at each branch duct. Determine the quantity of air remaining after each branch duct. Record answers in the space provided on the drawing.


Branch A
3.566 CFM
Branch C
1.942 CFM
After A ?
After B ?
After C ?
FAN
16.225 CFM
Branch B
2.142 CFM
Branch D
4.229 CFM
After D?
Branch E
2.346 CFM
After E?
Branch F
_?_ CFM

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #4 & #5

Solve problems that require computations with whole numbers. Use a calculator to solve problems.

PERFORMANCE OBJECTIVE #7

Given a calculator, solve application problems that require multiplying whole numbers.

INSTRUCTIONAL ACTIVITIES

Sample Items

A good mason can lay about 300 blocks per day. At this rate, how many would a mason lay in 5 days? (ans: 1,500 blocks)

Notes

Problems in multiplying whole numbers should involve more than solving a problem when two numbers are given -- 80 x 4 = 320. In the air conditioning trade many data sheets are used to record vital information and then solve problems. One such sheet is the Heating Data Sheet which requires the student to choose the numbers to be multiplied and then record the answer in the proper place.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 355.

EVALUATION

1. A parts delivery van travels at 86 kilometers per hour. How far has it gone after 3 hours?
2. A roll of wire weighs 20 kilograms. This type wire contains 348 meters of wire per kilogram. What is the total length of wire on the roll?
3. If a car has a 19-gallon tank and averages 16 miles to a gallon, how far can it travel on one tank of gas?
4. If one ream of stock weights 18 pounds, how much does 42 reams weigh?

ANSWERS TO EVALUATION

1. 258 km
2. 6,960 m
3. 304 miles
4. 756 pounds

ANSWERS TO APPLICATIONS

1. $2,363
2. $1,520
3. $132
4.

HEATING DATA SHEET

HEATING CONTRACTOR ______________________

NAME OF JOB ______________________

DATE ________ BY ________

OUTSIDE DESIGN TEMP -2° F

INSIDE DESIGN TEMP 70° F

DESIGN TEMP DIFF 72° F

1 Room Use and Floor Level				1 L.R		2 BR. #1		3 B.R. #2		4 D.R.	
2 Room Length and Width				18x16		12x13		14x13		10x14	
3 Running Ft. of Exposed Wall				34		12		27		24	
4 Ceiling Height				8		8		8		8	
5 Exposure Type	Table No.	"U" Factor	Multiplier	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss
Gross 6. Exposed Wall				272		96		216		192	
Windows 7. and Doors W			40	79	3160	18	720	18	720	36	1440
D			22	21	462						
Net 8. Exposed Wall			10	211	2110	78	780	198	1980	152	1560
9 Cold Partition											
10 Cold Ceiling			7	288	2016	156	1092	182	1274	140	980
11 Cold Floor			10	288	2880	156	1560	182	1820	140	1400
Infiltration, 12 (leakage) or Air Change			42	18	756	12	504	12	504	18	756
			70	21	1470						
13 Room Sub-Total Btuh					12,854		4,656		6,298		6,136
14 Btuh Adjustment											
15 Room Total Btuh											
16 Cfm @ Temp Rise											
17 Adjusted cfm											

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #7

Performance Objective #7: Given a calculator, solve application problems that require multiplying whole numbers.

1. Find the cost of 17,000 bricks at $139 per thousand.
2. Figure the total amount of a mason contractor's weekly payroll for 5 bricklayers who work 38 hours each at $8.00 per hour.
3. Find the cost of 11 tons of sand at $12 per ton.

4. Given a Heating Data Sheet with all necessary data recorded, determine the BTUH loss for the L.R., BR #1, BR #2, and D.R. by multiplying the AREA CRACK CFM by the MULTIPLIER. Record your answers in the BTUH column under each room.

HEATING DATA SHEET

DATE ________ BY ________

HEATING CONTRACTOR ____________________

OUTSIDE DESIGN TEMP -2° F

NAME OF JOB ____________________

INSIDE DESIGN TEMP 70° F

DESIGN TEMP DIFF 72° F

1. Room Use and Floor Level				1. L.R.		2. B.R. #1		3. B.R. #2		4. D.R	
2. Room Length and Width				18x16		12x13		14x13		10x14	
3. Running Ft. of Exposed Wall				34		12		27		24	
4. Ceiling Height				8		8		8		8	
5. Exposure Type	Table No.	"U" Factor	Multiplier	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss	Area Cfm	Btuh Loss
6. Gross Exposed Wall				272		96		216		192	
7. Windows and Doors			40	79		18		18		36	
			22	21							
8. Net Exposed Wall			10	211		78		198		156	
9. Cold Partition											
10. Cold Ceiling			7	288		156		182		140	
11. Cold Floor			10	288		156		182		140	
12. Infiltration, (leakage) or Air Change			42	18		12		12		18	
			70	21							
13. Room Sub-Total Btuh											
14. Btuh Adjustment											
15. Room Total Btuh											
16. Cfm @ Temp. Rise											
17. Adjusted cfm											

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCIES #4 & #5

Solve problems that require computations with whole numbers. Use a calculator to solve problems.

PERFORMANCE OBJECTIVE #8

Given a calculator, solve application problems that require dividing whole numbers.

INSTRUCTIONAL ACTIVITIES

Sample Item

A paper cutter operator cuts 4 equal lengths from a sheet measuring 36 inches. What is the length of each piece? (ans: 9")

Notes

Air Conditioning/Refrigeration: Data sheets are required to record information and then solve problems. Calculating heat loads on buildings is a good example. This form provides good practice in dividing whole numbers.

Define kerf: The width of the saw cut.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 356.

EVALUATION

1. A warehouse receives 38,000 transistor pockets. They are divided equally into 16 storage bins. How many are in each bin?
2. A total load of 15,840 watts is distributed equally over 12 circuits. What is the load per circuit in watts?
3. If 168,424 pieces are machined in 8 hours, how many are machined per hour?
4. How many rafters 42 inches long can be cut from a piece of lumber 168 inches long? (Do not allow for saw kerfs.)

ANSWERS TO EVALUATION

1. 2,375 pockets
2. 1,320 watts
3. 21,053 pieces
4. 4 rafters

ANSWERS TO APPLICATIONS

1. 7"

2. 9 3/5"

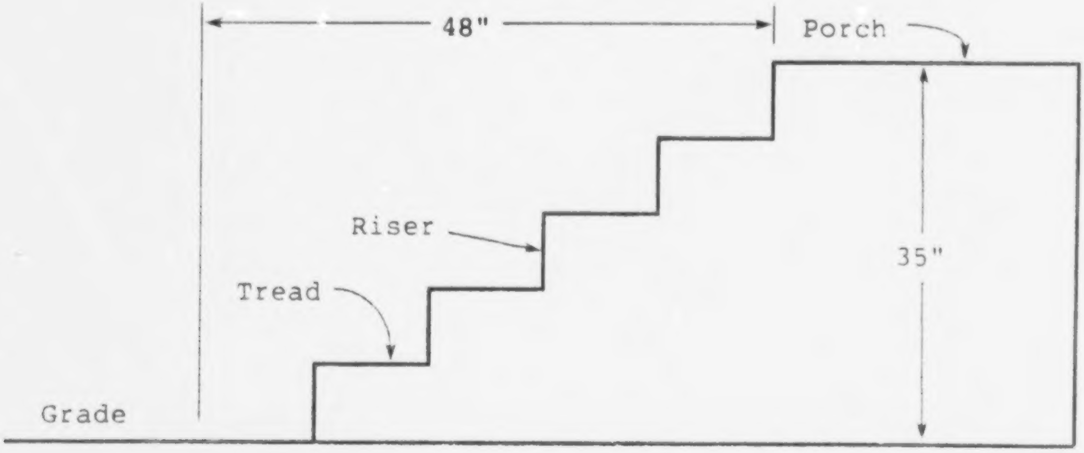
3. 42 sheets

4.

Windows		79
Doors		22
Net Wall		10
Ceiling		7
Floor		10
Infiltration	W:	42
	D:	70

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE 8

Performance Objective #8: Given a calculator, solve application problems that require dividing whole numbers.



1. Using the above drawing, what is the height of each riser?
2. What is the width of each tread?
3. If each 4' x 8' plywood sheet contains 32 square feet, how many sheets would be needed to floor 1,344 square feet?
4. The worksheet on the following page is used to make heat load calculations. Determine the HTF (Heat Transfer Factor) by dividing the BTUH (British Thermal Unit) loss by the area. Record the HTF in the column provided.

	AREA	HTF	BTUH LOSS
GROSS WALL	1,248	XXXXX	XXXXXXXXX
WINDOWS	158		12,482
DOORS	42		924
NET WALL	1,048		10,480
CEILING	1,440		10,080
FLOOR	1,440		14,400
	Crackage		
INFILTRATION W	47 lin. ft.		1,974
D	21 lin. ft.		1,470
TOTAL LOSS	XXXXXXXXXXXX	XXXXXX	51,810

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCIES #4 & #5

Solve problems that require computation with whole numbers.
Use a calculator to solve problems.

PERFORMANCE OBJECTIVE #9

Given a calculator, solve application problems involving all four basic operations with whole numbers.

INSTRUCTIONAL ACTIVITIES

Sample Item

In making five excavations, the following cubic meters of earth were removed: 5,040; 6,070; 7,940; 11,424 and 35,216. Find the total number of cubic meters of earth removed. (ans: 65,690 cubic meters)

Notes

The current text does not contain application problems involving all four operations with whole numbers.

REFERENCE TO TEXT

None

EVALUATION

1. 1,600 pounds of steel are used to make a Chevrolet. The automobile plant produced 840 Chevrolets in one day. How many pounds of steel were needed that day to make the cars?
2. Manny was working as a hot dog vendor. He sold a total of 426 hot dogs in one weekend. If he sold 198 on Saturday, how many did he sell on Sunday?
3. Last year, the Gonzales family paid $230 a month rent. If their rent increased by $35 a month, how much monthly rent are they paying now?
4. During a 12-hour day, the fast food restaurant sold 3,852 hamburgers. On the average, how many hamburgers were sold per hour?

ANSWERS TO EVALUATION

1. 1,344,000 pounds
2. 228 hot dogs
3. $265 per month
4. 321 hamburgers

ANSWERS TO APPLICATIONS

1. a) 2210 watts
   b) no

2. 161 inches

3. 903 gallons

4. 19,102 board feet

5. 788 pgs.

6. 52

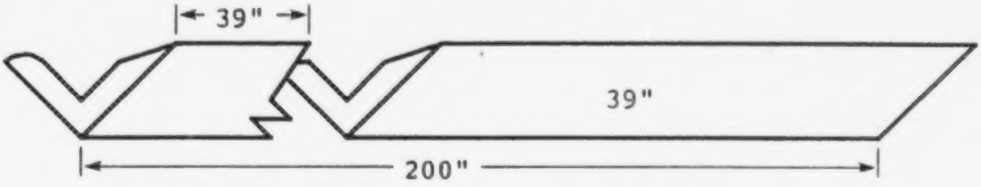
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #9

Performance Objective #9: Given a calculator, solve application problems involving all four basic operations with whole numbers.

1. A 20-ampere fuse will allow a maximum of 2300 watts of power to pass through it. If more power passes through the fuse, it will blow. A toaster draws 1395 watts of power, a lighting fixture draws 300 watts, a fan draws 455 watts and a stereo draws 60 watts.

   a) Determine the total power drawn by the four appliances, in watts.
   b) If all four appliances are turned on at the same time, will the fuse blow?

2. A welder is required to flame cut a piece of steel angle shown. After the cut piece is removed, how many inches of steel angle remains from the original piece? Disregard waste caused by the width of the torchcut.



3. Fifteen water tanks are constructed in a welding shop. The tanks hold a total of 13,545 gallons. How many gallons will each tank hold?

4. How many board feet of lumber are there in the following list of materials? 164 joists - 30 bd. ft. each; 15 girders - 96 bd. ft. each; 58 rafters - 25 bd. ft. each; 14 posts - 54 bd. ft. each; 396 boards - 16 bd. ft. each; 300 studs - 14 bd. ft. each.

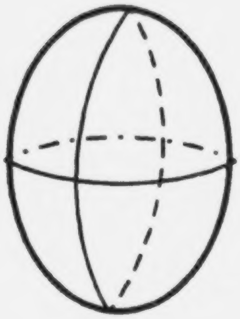
5. A woman takes out a 793-page book from the library. She reads 45 pages the first day she has the book, 107 pages during the second and third days, and 122 pages during the fourth, fifth and sixth days. She reads 83 pages during the seventh day, 37 pages during the eighth day, and during the next six days she read 394 pages. Determine the total pages she read during the two weeks.

6. Solve this problem:

   21 + 14 - 10 + 25 - 15 - 6 + 23 =

section II

linear measurement



COMPETENCY #6

Read an English unit ruler.

PERFORMANCE OBJECTIVE #10

Given a line segment and a ruler, measure the length of the segment to the nearest sixteenth of an inch.

INSTRUCTIONAL ACTIVITIES

Sample Item

Measure the length of this segment to the nearest sixteenth of an inch. Simplify when possible.

(ans. 3)

Notes

Construction: Most construction work is measured to the nearest sixteenth of an inch.

Machine Shop: A machinist must become adept at measuring with a rule to rough out parts quickly on the machines as well as to lay out parts accurately before machining if the degree of accuracy warrants. Practice in developing skills in measuring may be obtained by measuring lengths of lines on scale drawings of sheet metal patterns.

General: Supply students with several different types of rulers. After students understand the increments of the ruler, give them many opportunities to measure actual objects, not just line segments on paper. Be sure students understand the notation ' = feet and " = inches.

Welding: The steel tape measure is used to measure various lengths of steel in inches and fractional parts of inches.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 6-13.

EVALUATION

Measure these segments to the nearest sixteenth of an inch.

1. ____

2. ________

3. ____

4. __________________________________

ANSWERS TO EVALUATION

1. 4 5/16"
2. 13/16"
3. 5 8/16"
4. 3 3/16"

ANSWERS TO APPLICATIONS

1. a) 3/4"
    b) 2 2/4" or 2 1/2"
    c) 1"
    d) 2 3/8"
    e) 4 1/8"
    f) 9/16"
    g) 2 1/16"
    h) 4 9/16"

2. a) 3 7/8"
    b) 4 11/16"
    c) 4 8/16" or 4 1/2"
    d) 2 9/16"

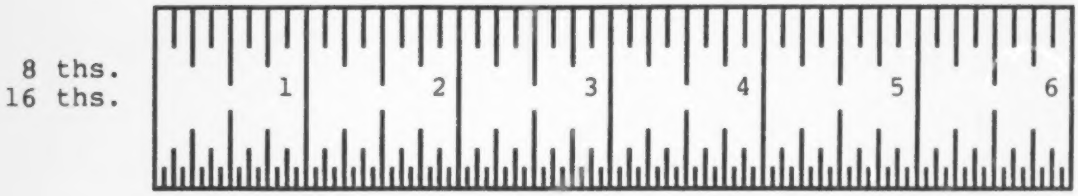
3. a) 6/16" or 3/8"
    b) 11/16"
    c) 1 2/16" or 1 1/8"
    d) 1 10/16" or 1 5/8"
    e) 2 2/16" or 2 1/8"
    f) 3 1/16"
    g) 3 12/16" or 3 3/4"
    h) 4 15/16"

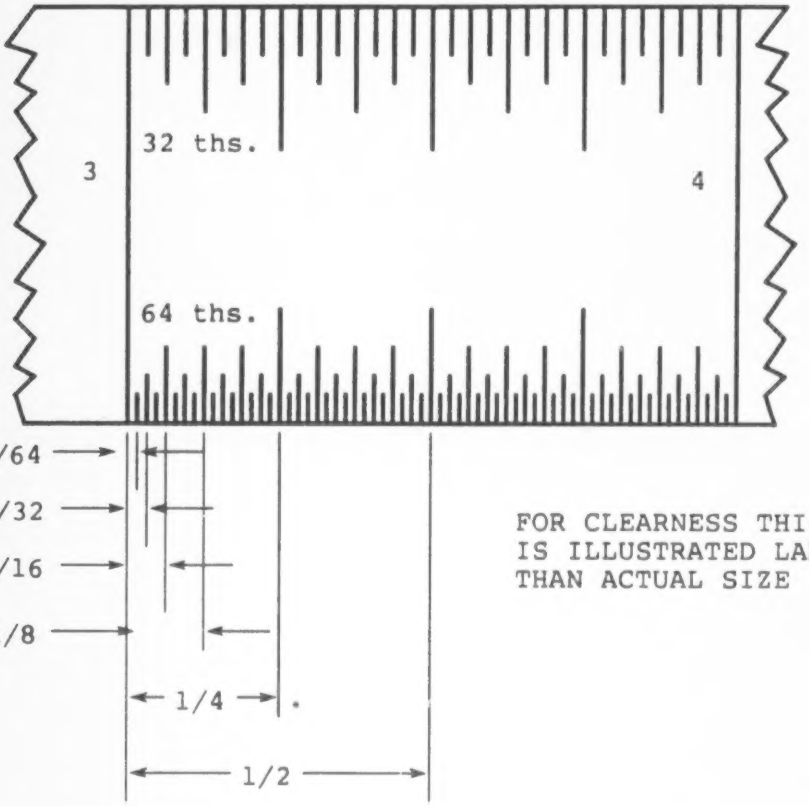
4. a) 2 15/16"
    b) 4 1/4"
    c) 3 3/4"
    d) 2 1/4"
    e) 3 1/4"

5. AJ = 2 1/16"
    AC = 2 13/16"
    AH = 1 1/16"
    CF = 1 1/16"
    JK = 1 1/8"
    JF = 3"

Note: Answers may vary due to measuring instruments or alterations occurring during printing.

6" STEEL SCALE


8 ths.
16 ths.
1
2
3
4
5
6

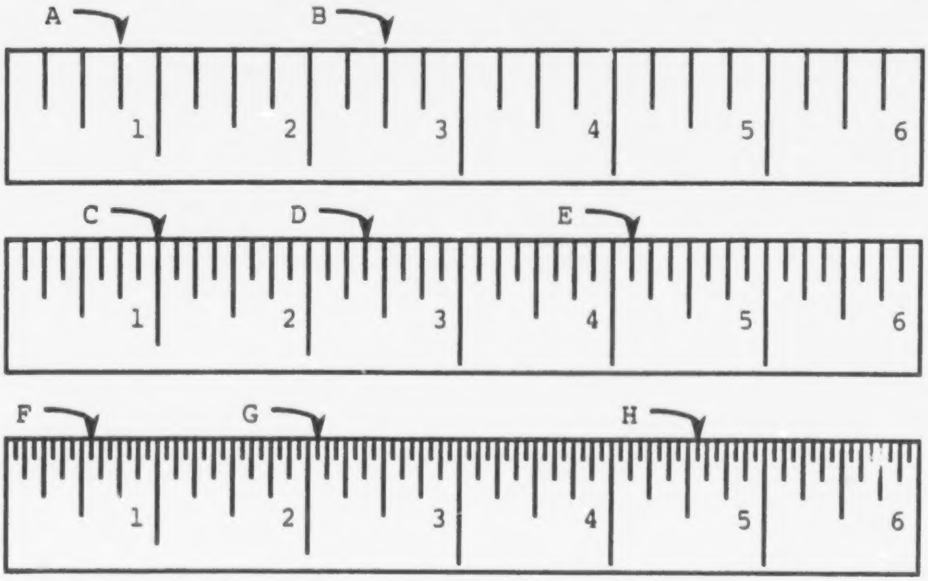

3
32 ths.
4
64 ths.
1/64
1/32
1/16
1/8
1/4
1/2

FOR CLEARNESS THIS SCALE
IS ILLUSTRATED LARGER
THAN ACTUAL SIZE

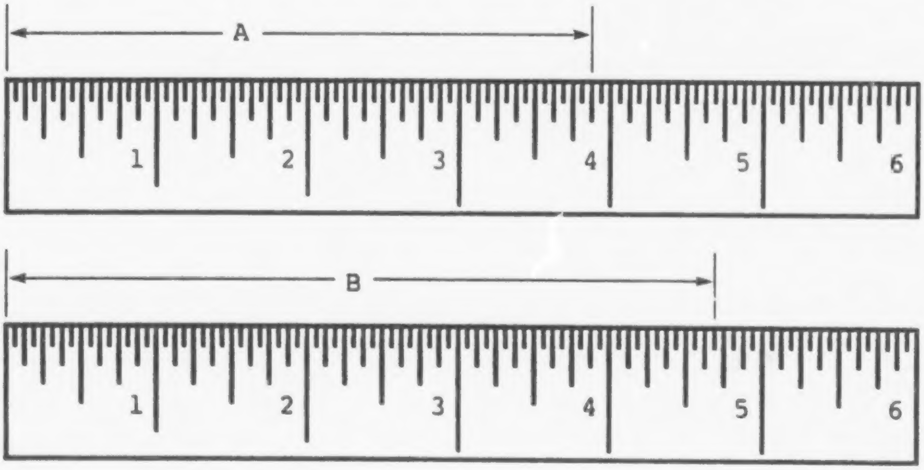
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #10

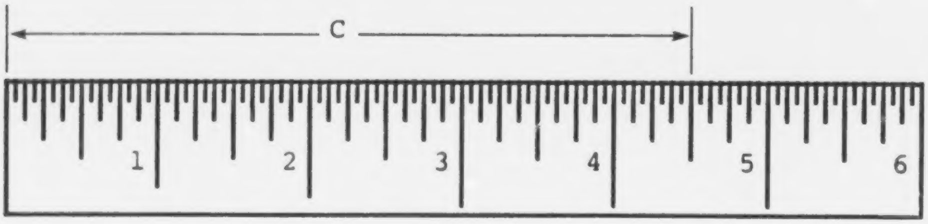
Performance Objective #10: Given a line segement and a ruler, measure th length of the segument to the nearest sixteenth of an inch

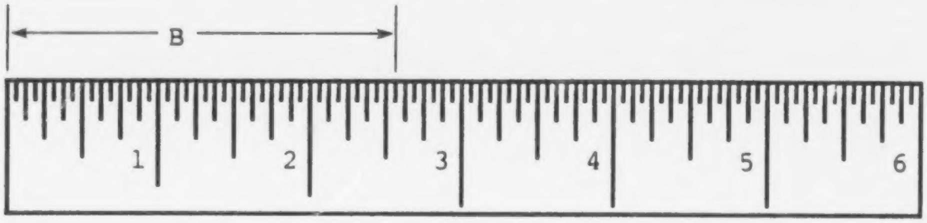
1. Read the distance from the start of the steel tape measure to the letters on the tape measure.


A
B
1
2
3
4
5
6
C
D
E
1
2
3
4
5
6
F
G
H
1
2
3
4
5
6

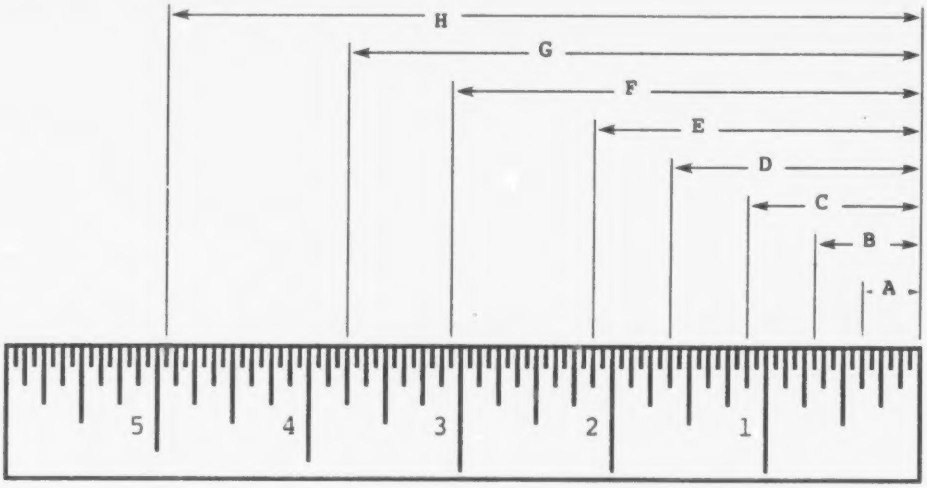
2. What is the length indicated on each of these machine shop rules?


A
1
2
3
4
5
6
B
1
2
3
4
5
6





3. Below is a portion of a rule used by masons. You are to write, in figures, the inches and fractional parts of an inch that are represented by the dimensions lettered "A" to "H", inclusive. (The ruler shown is slightly smaller than actual size.)


H
G
F
E
D
C
B
A
5
4
3
2
1

4. Using a bench ruler such as a carpenter would use, measure the following lines to the nearest sixteenth of an inch. Simplify when possible.

   a) ____________________________________

   b) ____

   c) ____

   d) ____________________________

   e) ____

5. Sheet metal patterns are used to assist in laying out fittings. The patterns are not dimensioned so they can be used to make any size fitting.

   On the given sheet metal patterns, lengths of lines are identified by letters, for example, AH or AJ. Measure the lines indicated below and record the length to the nearest sixteenth of an inch. Simplify when possible.

   AJ = ________

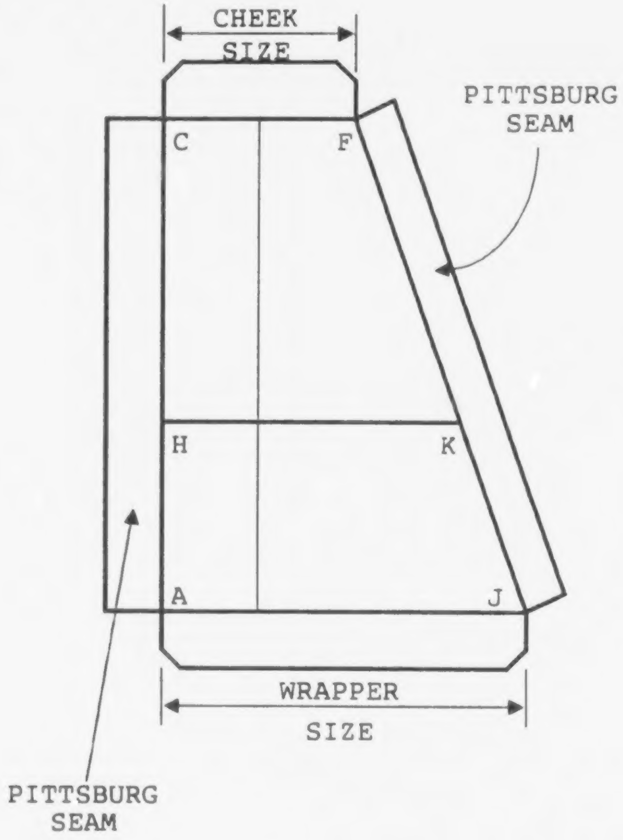
   AC = ________

   AH = ________

   CF = ________

   JK = ________

   JF = ________


CHEEK
SIZE
PITTSBURG
SEAM
C
F
H
K
A
J
WRAPPER
SIZE
PITTSBURG
SEAM

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #7

Explain the meaning of common fractions.

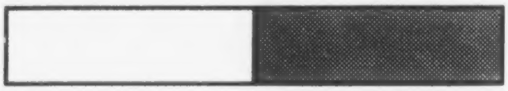
PERFORMANCE OBJECTIVE #11

Given a common fraction, draw a pictorial representation.

INSTRUCTIONAL ACTIVITIES

Sample Item

Draw a pictorial representation of 1/2.



Notes

General: Students frequently have difficulty with fractions because they do not understand the meaning of fractions. Enhance this understanding by reading fractions in different ways and by drawing them in different ways. For example, 1/2 may be explained as "For every girl there will be 2 boys," or "one part oil for 2 parts gas". Pictures can show area such as the sample above or distance (such as a ruler) or pieces such as ☐ ☒ .(This could be read "one out of two".) Stress unit fractions first (1/2, 1/3, 1/4, etc.), then fractions equal to a whole (2/2, 3/3, 4/4, etc.) Use manipulatives as much as possible.

When doing any type of fabrication, understanding of fractional parts is essential. One must be able to visualize the part of the whole. Practice is needed in dividing actual items or things.

Welding: Standard sheet metal and sheet steel when ordered come in 4' x 8' sheets.

Ex. 1/4" x 4' x 8' = 1/4" thickness, 4' wide, 8' long

REFERENCE TO TEXT

None

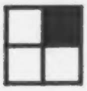
EVALUATION

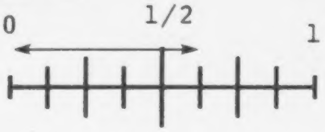
Draw pictorial representations for each of the following fractions.

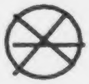
1. 1/4
2. 5/8
3. 6/6
4. 3/4

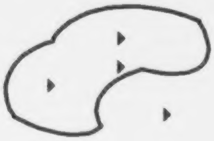
ANSWERS TO EVALUATION

Note: Drawings will vary. The drawings below are just examples.

1. 

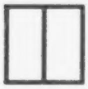
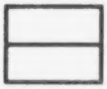
2. 

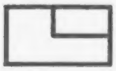
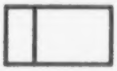
3. 

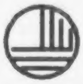
4. 

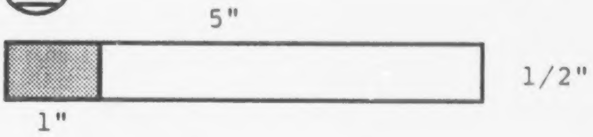
ANSWERS TO APPLICATIONS

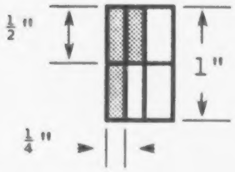
Note: Not shown actual size.

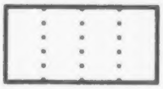
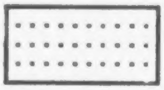
1.  OR 

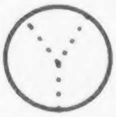
2.  OR 

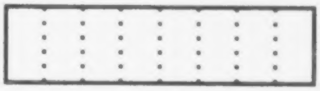
3. a) 

b) 

a) 

4.  OR 

5. 

6. 

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #11

Performance Objective #11: Given a common fraction, draw a pictorial representation.

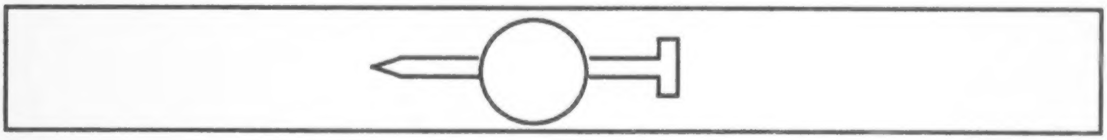
1. On the sheet of steel below draw a cut line for the welder to cut the sheet in half.

2. On the sheet of steel below draw a cut line for the welder to cut 1/4 of the sheet out.

3. Draw a pictorial representations as required.
   a) A 1" diameter circle with 3/4 of it shaded.
   b) A 1/2" x 5" rectangle with 1/5 shaded.
   c) A 1 inch square with 3/8 shaded.

4. Given a rectangular piece of copper 8" x 24", divide the piece into one-fourths (1/4) by drawing dashed lines.

5. Given s sheet metal damper 6 inches in diameter, divide it into one-thirds (1/3) by drawing dashed lines.



6. A 4-inch diameter plastic pipe is 8 ft. long. Divide the pipe into one-eighths (1/8) by drawing dashed lines.

COMPETENCY #8

Compare fractions.

PERFORMANCE OBJECTIVE #12

Given two common fractions, tell which is larger or state that they are equivalent.

INSTRUCTIONAL ACTIVITIES

Sample Item

Replace the question mark with < (less than), > (greater than) or = (equals).

3/16 ? 1/8 (ans: >)

Notes

General: Student typically compare fractions by cross-multiplying or getting common denominators. Another method is to compare lengths on a ruler when appropriate denominators are used.

Help students learn the general rules for comparing fractions with like numerators as well as like denominators. If the numerators are the same, the fraction with the larger denominator is smaller because the whole as been divided into more (and therefore, smaller) pieces.

Screws, nuts, bolts, rods, pipe and tubing are used in most trade areas. These items are identified by fractional size. Students must be able to compare correctly various fractional sizes.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 364.

EVALUATION

Replace the ? with <, > or = .

1. 5/32 ? 11/16

2. 1/2 ? 3/8

3. 3/4 ? 12/16

4. 6/8 ? 11/16

ANSWERS TO EVALUATION

1. <
2. >
3. =
4. >

ANSWERS TO APPLICATIONS

1. a) <
   b) >
   c) =
2. a) 9/16
   b) 3/10
   c) 13/24
   d) 7/12
   e) 1/16
   f) 4/16
3. 1/4
4. a) no
   b) 5/8
5. Fig. A

APPLICATIONS FOR PERFORMANCE OBJECTIVE #12

Performance Objective #12: Given two common fractions, tell which is larger or state that they are equivalent.

1. Place the appropriate symbol (>, <, =) between the following fractions.

   a) 2/3 ? 3/4
   b) 3/5 ? 4/7
   c) 3/5 ? 21/35

2. Determine the smaller fraction.

   a) 3/4 or 9/16
   b) 3/10 or 12/30
   c) 7/12 or 13/24
   d) 7/12 or 10/16
   e) 1/16 or 1/8
   f) 4/15 or 4/16

3. Nut drivers are used to loosen and tighten hex head screws. Two nut drivers are available: 3/16 and 1/4. Which one is the larger?

4. Copper tubing is measured by outside diameter (O.D.) when used in refrigeration work. There is a need for 1/2" O.D. copper tubing. Tubing available is 1/4, 3/8, 5/16, and 5/8.

   a) Is 1/2" O.D. available?
   b) Of the tubing available, which is larger than 1/2"?

5. Two pipes have the same inside diameter but the wall thickness is different. Which pipe has the thickest walls? Drawings are not to scale.

Fig. A

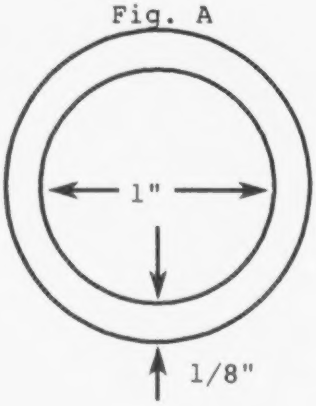
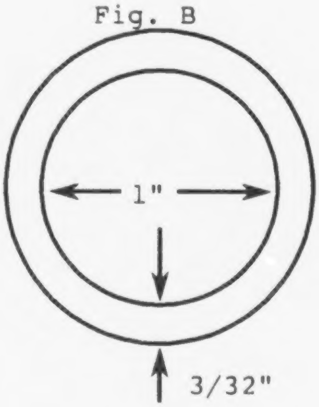


Fig. B



COMPETENCY #9

Give equivalent fractions.

PERFORMANCE OBJECTIVE #13

Given a common fraction and a new denominator, write an equivalent fraction.

INSTRUCTIONAL ACTIVITIES

Sample Item

3/4 = ?/8 (ans: 6)

Notes

Comparison of different sizes of nuts, bolts, screws, washers, pipe and tubing is necessary when doing installation and service work. Students should be able to convert from one denominator to another denominator.

Manipulatives such as egg cartons help in visualizing equivalent fractions.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 362.

EVALUATION

Replace the ? with a number to make an equivalent fraction.

1. 3/5 = ?/10
2. 5/8 = ?/16
3. 10/16 = ?/8
4. 6/8 = ?/4

ANSWERS TO EVALUATION

1. 6

2. 10

3. 5

4. 3

ANSWERS TO APPLICATIONS

1. a) 1/2
   b) 4/2
   c) 1/2
   d) 8/2

2. a) 4/8
   b) 28/8
   c) 2/8
   d) 2/8

3. a) 24/64
   b) 30/64
   c) 28/64
   d) 12/64

4. a) 1/2
   b) 1/2
   c) 5/8
   d) 9/64
   e) 3/8
   f) 1/8

5. a) 1/8 = 4/32
   b) 1/2 = 16/32
   c) 3/16 = 6/32
   d) 1/4 = 8/32
   e) 5/8 = 20/32
   f) 5/16 = 10/32

6. a) no
   b) 5/16 = 20/64
   c) 1/4 = 16/64

7. 12/16

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #13

Performance Objective #13: Given a common fraction and a new denominator, write an equivalent fraction.

1. Reduce to halves.

   a) 2/4
   b) 16/8
   c) 4/8
   d) 32/8

2. Change to eighths.

   a) 1/2
   b) 7/2
   c) 1/4
   d) 4/16

3. Change to sixty-fourths.

   a) 3/8
   b) 15/32
   c) 7/16
   d) 24/128

4. Reduce to lowest terms.

   a) 4/8
   b) 5/10
   c) 10/16
   d) 9/64
   e) 12/32
   f) 8/64

5. Bin labels are being prepared for a large selection of washers. To be sure that the labels are applied to the bins in an increasing order (smallest to largest), it is necessary to change all washer sizes to a common denominator. Write each fraction with a denominator of 32.

   a) 1/8
   b) 1/2
   c) 3/16
   d) 1/4
   e) 5/8
   f) 5/16

6. A 5/15" bolt and a 1/4" nut are to be used to clamp two pieces of metal together.

   a) Will the two screw together?

   Prove by changing both fractions to new fractions with denominators of 64.

   b) 5/16
   c) 1/4

7. A piece of metal is 3/4" thick. How would this thickness be identified with a denominator of 16?

COMPETENCY #10

Add, subtract, multiply and divide fractions.

PERFORMANCE OBJECTIVE #14

Given any combination of fractions, mixed numbers and whole numbers, find the sum.

INSTRUCTIONAL ACTIVITIES

Sample Item

Add: 2 3/4 + 1 7/8 (ans: 4 5/8)

Notes

Calculating the length of material (wood, pipe, wire, etc.) needed to fabricate items or install equipment is of importance in the shop. Seldom are all measurements whole numbers, so the addition of whole numbers, fractions and mixed numbers will be the rule.

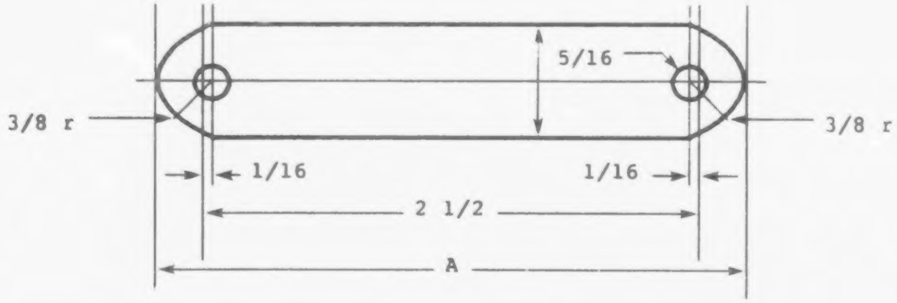
Masons and carpenters use fractions extensively, especially with denominators of 2, 4, 8, 16 and 32.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 365.

EVALUATION

1. What will be the length of a piece of 2 x 4 lumber needed to cut the following pieces? Allow 1 1/2" for waste and kerfs. One piece is 3/4" long, one piece is 1 5/8" long, one piece is 15" long and one piece is 14 1/2" long.
2. Find the length of A on the sketch of link shown below. Figure is not drawn to scale.



3. For a job a mason estimates that the following amounts of mortar are needed.

   a) 20 1/2 cubic yards
   b) 8 2/3 cubic yards
   c) 11 1/4 cubic yards

   How many cubic yards are needed altogether?

4. What is the total thickness of a wall having 7/8 inch finish siding, 7/8 inch rough siding, 3 3/4 inch studs, and 13/16 inch of lath and plaster?

ANSWERS TO EVALUATION

1. 33 3/8"
2. 3 3/8"
3. 40 5/12 cubic yards
4. 6 5/16"

ANSWERS TO APPLICATIONS

1. 9 3/4 hours
2. 4 15/16"
3. 29 square yards
4. 57 15/16"
5. 17 1/8"
6. 16" x 10 3/4"
7. 7 5/32"
8. 161 5/8"
9. a) 13 1/4"
   b) 8 1/2"
10. 3 1/8"
11. 4 1/8"
12. 23 5/12 cubic yards
13. 3"

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #14

Performance Objective #14: Given any combination of fractions, mixed numbers and whole numbers, find the sum.

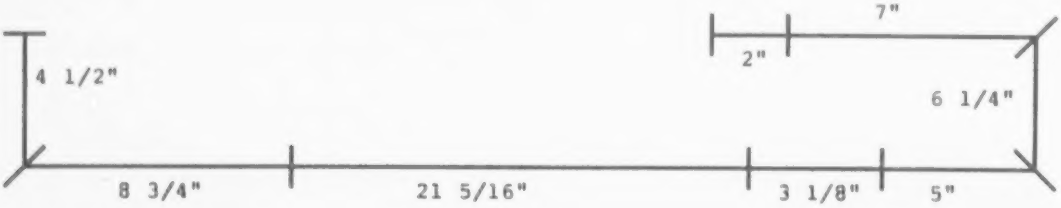
1. A carpenter worked 1/3 hour, 3 3/4 hours, and 5 2/3 hours. How many hours did the carpenter work?

2. What will be the total thickness of a wall allowing for 1/2" sheathing, a 3 1/2" stud and 15/16" lath and plaster?

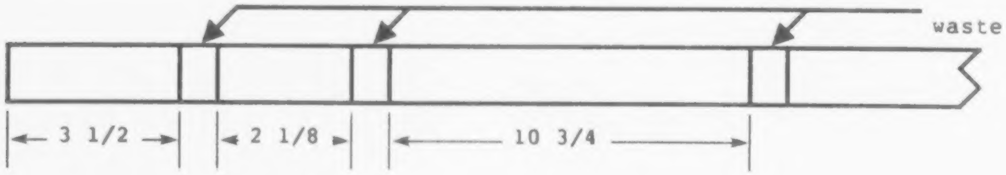
3. A concrete finisher charges by the square yard. What is the total square yardage for these three jobs?

    a) 5 square yards
    b) 6 1/2 square yards
    c) 17 1/2 square yards

4. An assembly is to be made using 1/2" pipe. The length of each piece is given on the sketch. What is the total length of pipe needed? There is no waste when cutting.

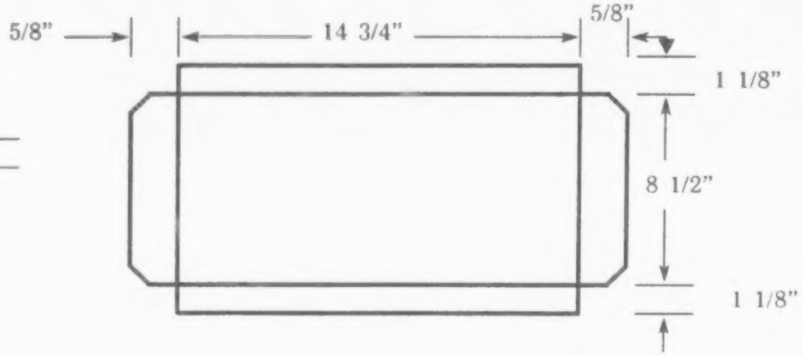


5. A piece of metal is to be cut into smaller pieces using a saw. The amount of waste for each cut is 1/4". What is the length of metal needed to make the size pieces shown on the diagram below?

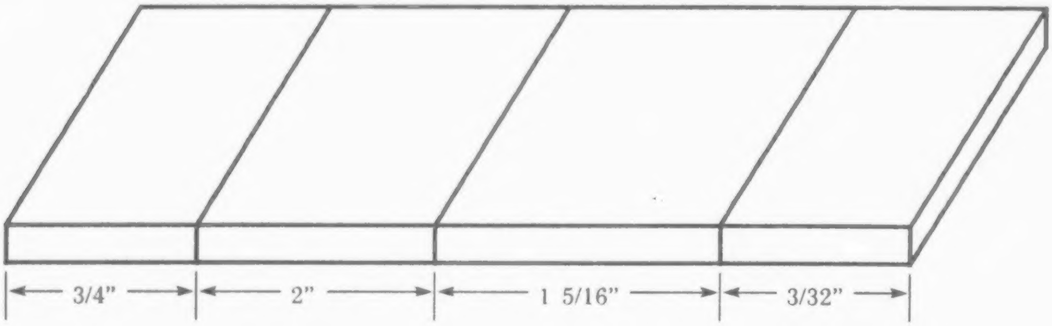


6. The item below is to be made from sheet metal. What size of metal will be required? State size in length and width.

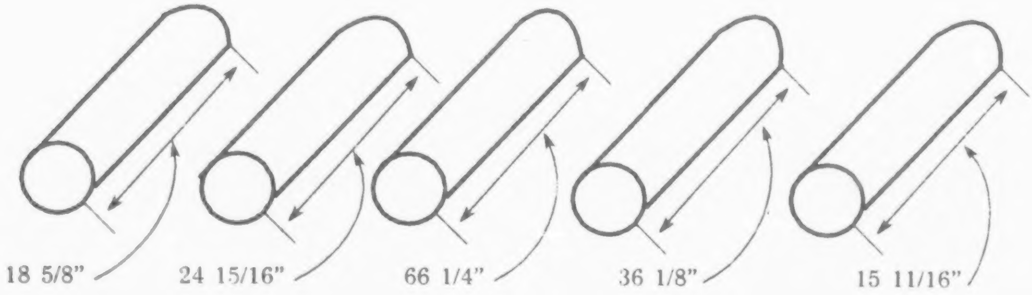
Length __________
Width __________


5/8"
14 3/4"
5/8"
1 1/8"
8 1/2"
1 1/8"

7. Four pieces of 2 inch cold rolled bar are welded together. What is the total length of the completed weldment?

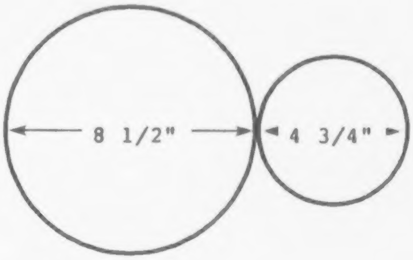

3/4"
2"
1 5/16"
3/32"

8. A weld shop has 5 pieces of 3/4 inch bar stock. When welded together, what will be the total length of the bar?

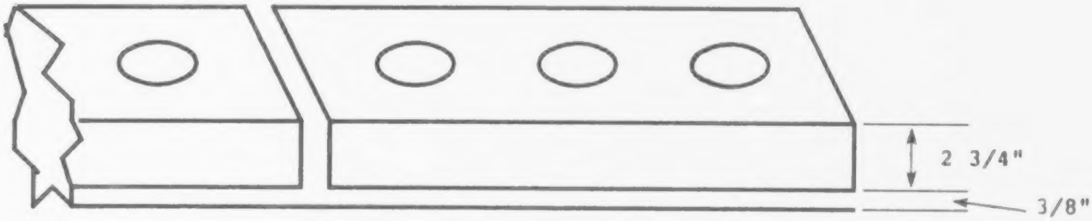

18 5/8"
24 15/16"
66 1/4"
36 1/8"
15 11/16"

9. Two pieces of circular steel must be cut from a sheet of 1/2 inch plate.

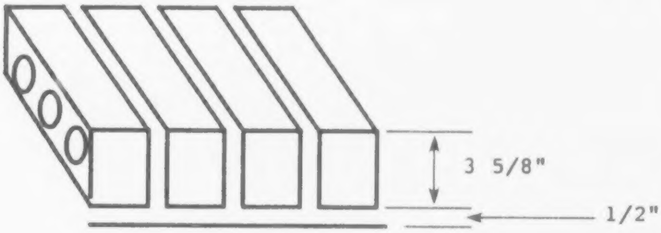
   a) What is the length of the plate?
   b) What is the width of the plate?



10. Find the height of a stretcher course of brickwork if the face of the brick is 2 3/4" high and the mortar joint is 3/8" thick.

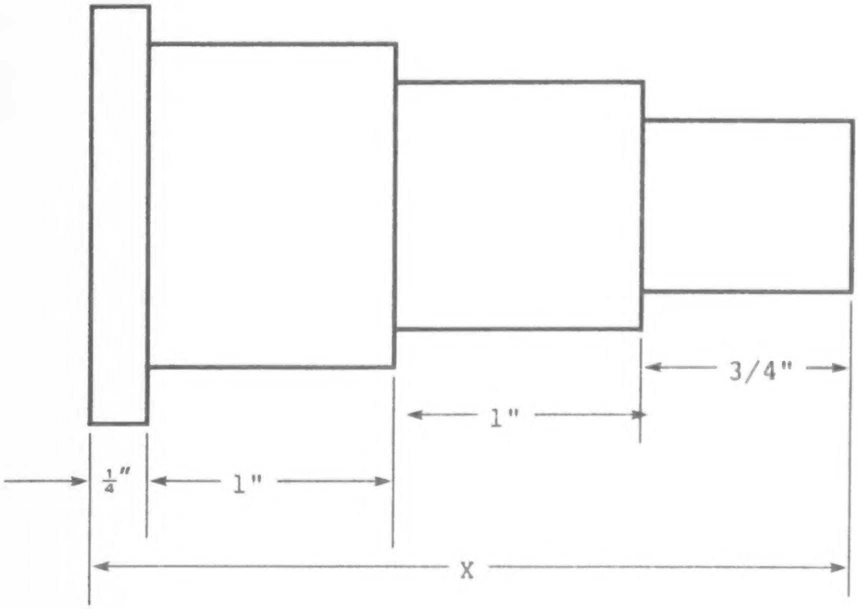


11. Find the height of a rowlock course of brickwork is the brick is 3 5/8" high, and the mortar joint is 1/2" thick.



12. Three cement finishers poured the following amounts of cement in one day -- 7 2/3 cubic yards, 6 1/4 cubic yards, and 9 1/2 cubic yards. What was the total amount of cement poured by them that day.

13. The student machinist must find the length "X" of the Step Pin given the dimensions below.



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #10

Add, subtract, multiply and divide fractions.

PERFORMANCE OBJECTIVE #15

Given any combination of fractions, mixed numbers and whole numbers, find the difference.

INSTRUCTIONAL ACTIVITIES

Sample Item

A plan for constructing a table top requires boards 1 3/16" thick. The thickness of the boards to be used is 1 1/2". How much must be planed from the boards?

Solution: 1 1/2 - 1 3/16 = (ans: 5/16")

Notes

Carpentry: In carpentry and woodworking, it is often necessary to remove material from stock thickness lumber to achieve the desired thickness. This requires subtracting fractions.

Welding: While making a part from a blueprint, a welder often finds it necessary to subtract fractions and mixed numbers to find location of drilled or cut holes and lengths of material.

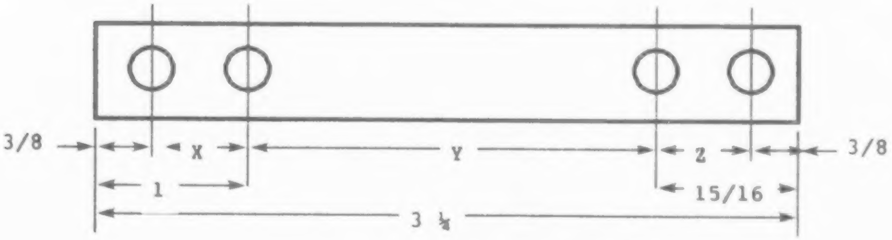
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 366-367, 38-39.

EVALUATION

1. An electrician worked 34 1/2 hours last week and 44 3/4 hours this week. How much longer did the electrician work this week?

2. Find dimensions X, Y, and Z.



ANSWERS TO EVALUATION

1. 10 1/4 hours

2. X = 5/8; Y = 1 5/16; Z = 9/16

ANSWERS TO APPLICATIONS

1. a) 6 1/4"
   b) 7/8"
   c) 7 1/8"

2. a) 13 3/8"
   b) 9 1/4"
   c) 4 1/8"

3. a) 13/16"
   b) 15/32"
   c) 1/16"

4. a) 4' 3"
   b) 16' 4 1/2"
   c) 17' 11"

5. 7/16"

6. 1 31/32"

7. 5/8"

8. 2 1/2"

9. 3 1/4 sq. yds.

10. 5 7/8"

11. 28 1/4"

12. 4 5/16"

13. a) 3 13/16"
    b) 1 1/2"
    c) 1 1/2"
    d) no
    e) Left to right: 11/32", 15/32", 3/8", 15/32"
    f) Left: 9/32"
       Right: 5/16"
    g) Left to right: 1/8", 1/4", 7/32", 9/32", 5/16"

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #15

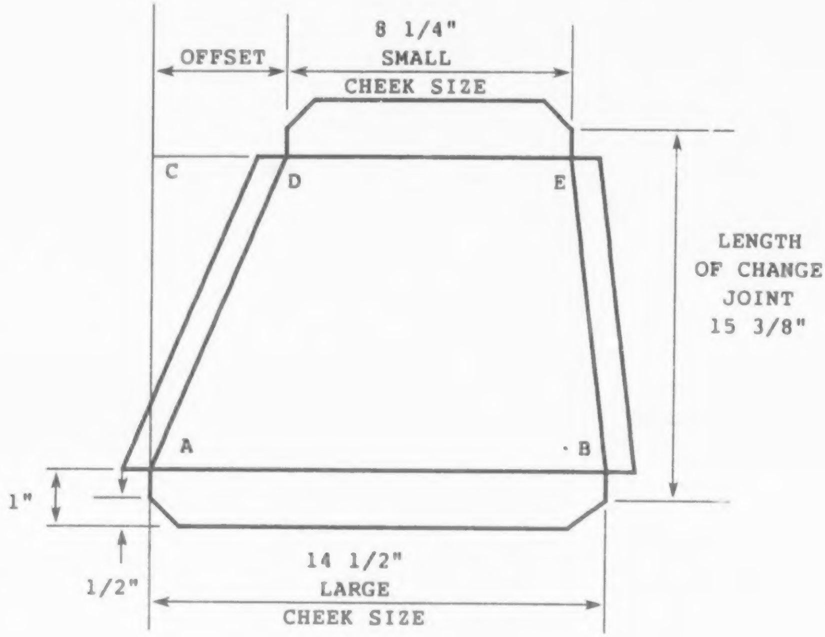
Performance Objective #15: Given any combination of fractions, mixed numbers and whole numbers, find the difference.

1. On the pattern below, determine the difference between the following dimensions. (The sizes are identified by letters: e.g., large cheek size is AB or 14 1/2".)

   a) Difference between AB & DE ____________

   b) Difference between AB & BE ____________

   c) Difference between BE & DE ____________



OFFSET
8 1/4"
SMALL
CHEEK SIZE
C
D
E
LENGTH
OF CHANGE
JOINT
15 3/8"
A
B
1"
1/2"
14 1/2"
LARGE
CHEEK SIZE

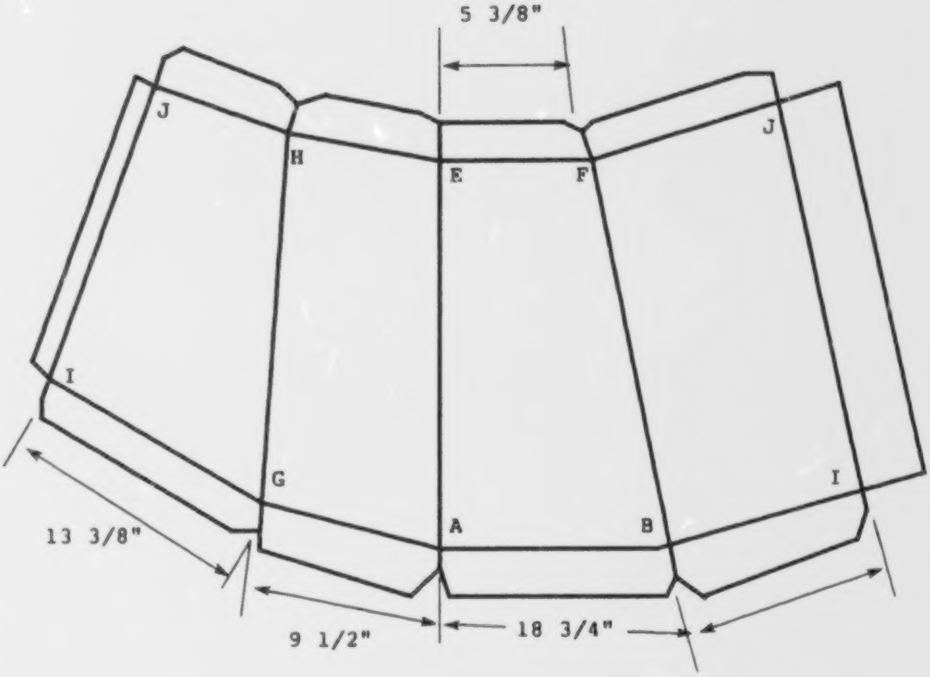
CHEEK PATTERN

2. On the pattern below, determine the difference between the following dimensions.

a) AB & EF = ____________

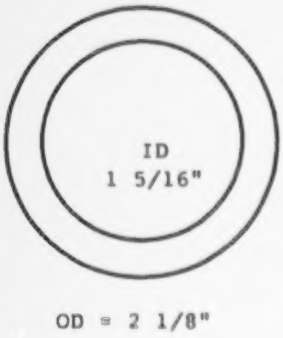
b) AB & GA = ____________

c) GA & EF = ____________

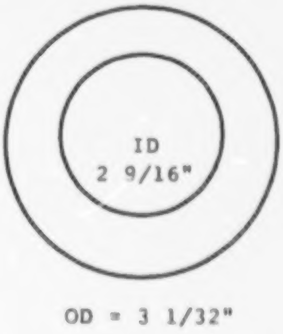

5 3/8"
J
H
E
F
J
I
G
A
B
I
13 3/8"
9 1/2"
18 3/4"

3. Determine the wall thickness of the following pipes. ID is inside diameter. OD is outside diameter.

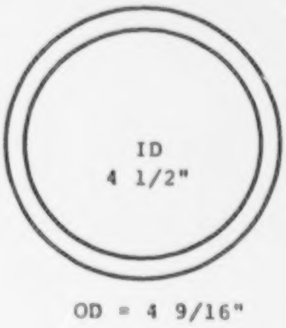
A.

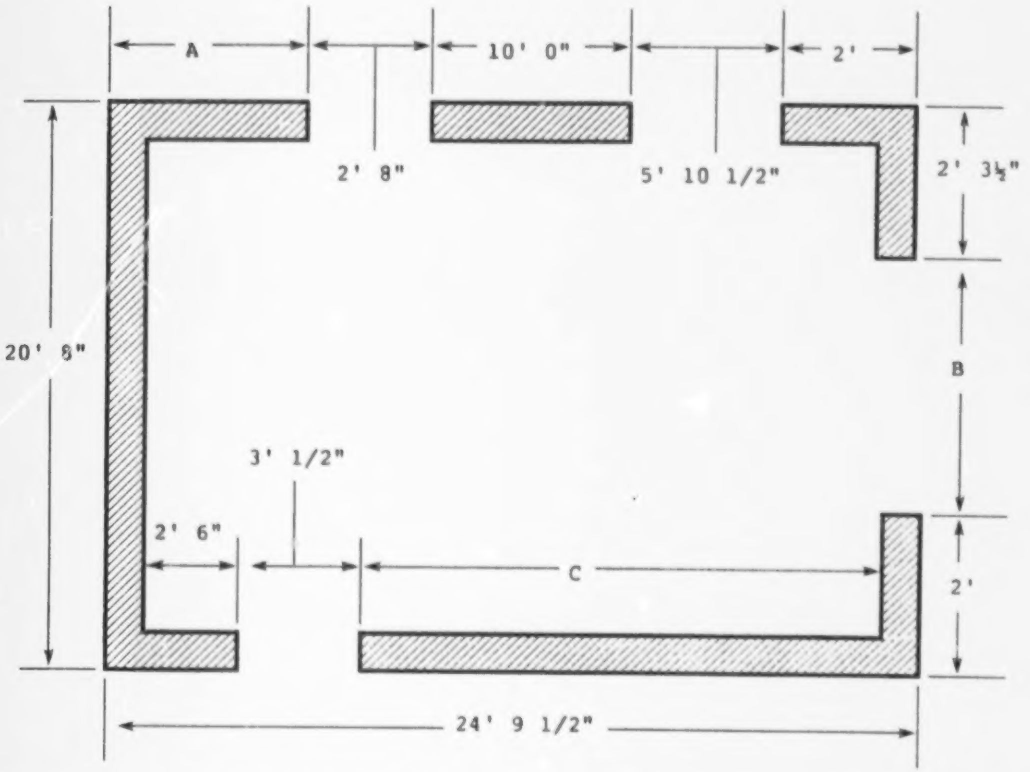

ID
1 5/16"
OD = 2 1/8"

B.


ID
2 9/16"
OD = 3 1/32"

C.


ID
4 1/2"
OD = 4 9/16"


A
10' 0"
2'
2' 8"
5' 10 1/2"
2' 3½"
20' 8"
B
3' 1/2"
2' 6"
C
2'
24' 9 1/2"

4. Using the above blueprint of a block garage, find these dimensions.

A =
B =
C =

5. Find the thickness of a rough board 1/2 inch thick after 1/16 inch is taken off by planing on one side.

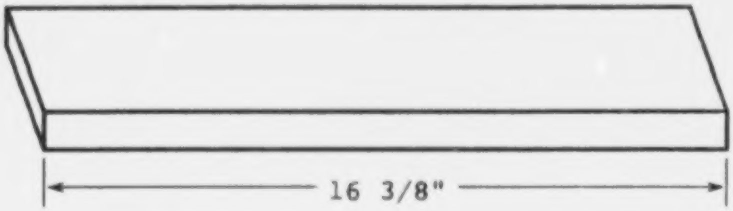
6. The total thickness of a counter top is 2 1/16 inches after being covered with 3/32 inch rigid plastic. What is the thickness of the top before covering?

7. The thickness of a piece of three-ply wood is 3/4 inch. It was made by gluing 1/16 inch pieces on both faces. What is the thickness of the original piece?

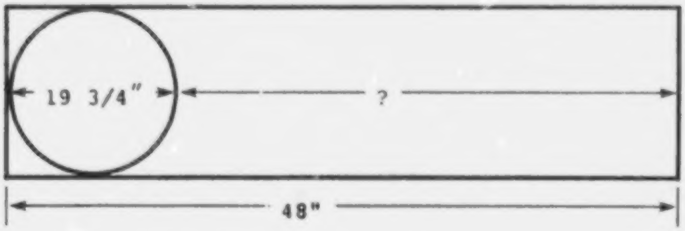
8. Subtract 1 1/2 inches from 4 inches.

9. Subtract 9 1/4 square yards from 12 1/2 square yards.

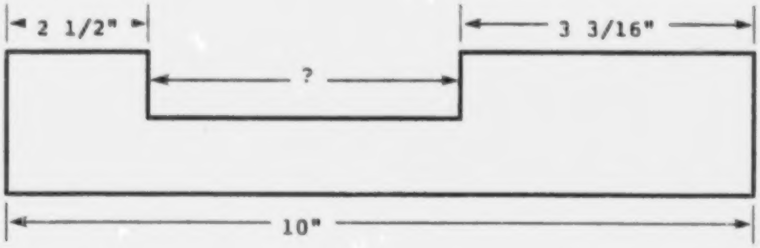
10. A 10 1/2" long piece of bar stock is cut from this piece. How much of the bar stock is left?



11. A 19 3/4" diameter circle is cut from this plate. Find the missing dimension.



12. A piece of steel is to be flame cut to the shape shown. Find the missing dimension.



13. In the part shown below:

a) Find the overall length.

b) Find the distance from the center of the 3/16" hole to the center of the 7/16" hole.

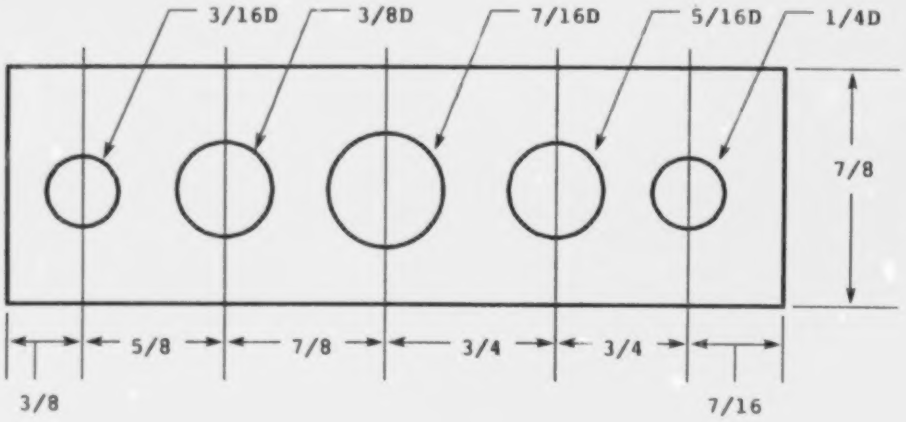
c) Find the distance from the center of the 1/4" hole to the center of the 7/16" hole.

d) Is the 7/16" in the center of the overall length?

e) Calculate the wall thickness between each of the holes.

f) What is the distance between the left edge of the part and the 3/16" hole; and, the distance between the right edge and the 1/4" hole?

g) What is the wall thickness between each hole and the long edge of the part?



COMPETENCY #10

Add, subtract, multiply and divide fractions.

PERFORMANCE OBJECTIVE #16

Given any combination of fractions, mixed numbers and whole numbers, find the product.

INSTRUCTIONAL ACTIVITIES

Sample Item

In determining the allowance made for the plumb cut of a rafter, one must allow one-half of the thickness of the ridge itself. Find the allowance when the ridge is 1 1/2" thick.

Solution: 1/2" x 1 1/2" = 3/4" Thus, the allowance is 3/4".

Notes

Air Conditioning: Multiplication of fractions and mixed numbers is required when constructing items that must be in the proper proportion for strength, proper flow of air or other technical reasons. Students should estimate by rounding off to see if answer is reasonable.

Welding: A welder must determine the material needed for making more than 1 piece for a job. (Ex.--10 pieces 8 1/2" long)

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 368, 40-41.

EVALUATION

1. How long a piece of drill rod is required to make 20 drills 3 3/6" long if 1/8" waste is allowed for each cut? (Note: only 19 cuts are made.)
2. Calculate the weight of 12 bars of cold rolled steel, each bar 11 3/4' long if the stock weighs 2 3/8 lbs. per foot.
3. If there are 7 1/2 gallons to the cubic foot, how many gallons of oil will a 4 3/4 cubic foot tank hold?
4. 1/4 x 7 1/8 =

ANSWERS TO EVALUATION

1. 66 1/8"
2. 334 7/8 lbs.
3. 35 5/8 gallons
4. 1 25/32

ANSWERS TO APPLICATIONS

1. 8 1/4"
2. 17 7/16 lbs.
3. 2 9/32"
4. 306 1/4 minutes or 5 5/48 hours
5. 42 1/2"
6. 115 1/2"
7. 157 1/2"
8. 16 1/8 hours
9. 200 hours
10. 25 13/16 ft.
11. a) 35 5/8"
    b) 15 7/16"
    c) 11 9/32"
12. a) 8 1/8"
    b) 11 1/4"
    c) 14 3/8"
13. 183 6/7 ft.
14. 4 1/2 tons
15. 38 3/4"
16. 58"

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #16

Performance Objective #16: Given any combination of fractions, mixed numbers and whole numbers, find the product.

1. To find the circumference of a circle, multiply the diameter by 3 1/7. What is the circumference of a circle whose diameter is 2 5/8"?

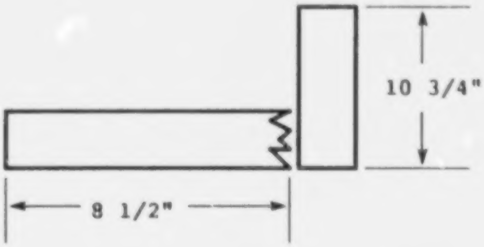
2. What is the weight of a piece of steel 15 1/2 feet long if the stock weighs 1 1/8 lbs. per foot?

3. How long a piece of stock will be required to cut 15 washers each 3/32" thick if 1/16" waste is allowed for each cut? (Note: 14 cuts)

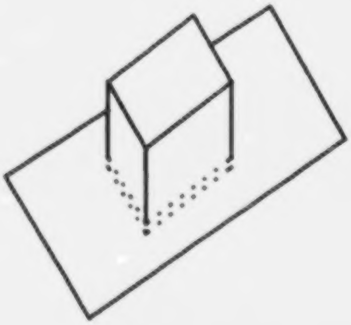
4. Allowing 1 1/2 minutes each time for putting away the finished work and placing the stock in the lathe, how long will it take to machine 25 pins if each pin requires 10 3/4 minutes to machine?

5. A welder needs 5 pieces of angle iron 8 1/2 inches long. How many inches of angle iron are needed for the job?

6. Six of these welded brackets are needed. What is the total length, in inches of the stock needed for all the brackets?



7. Three welding rods are needed to complete this weld. In 8 hours, 52 1/2 weldments are completed. How many welding rods are used?



8. How long will it take to drive a 21 1/2 foot pipe into the earth if it takes 3/4 hr. per foot?

9. A room has 800 sq. ft. of wall area. It requires 1/4 hr. to install 1 sq. ft. of wall covering. How long will it take to cover the walls of the room?

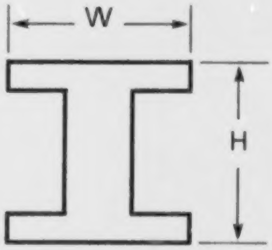
10. A log 7/8 the length of one 29 1/2 feet long is to be cut. What is the length?

11. The height of an I-beam is 2 3/8 times the width. Find the height for each of the following widths: 15", 6 1/2", 4 3/4".

a) When W is 15" then H = ___________

b) When W is 6 1/2" then H = ___________

c) When W is 4 3/4" then H = ___________

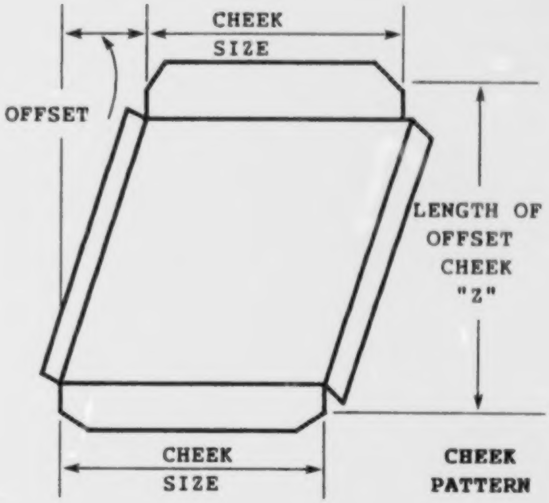


12. The pattern below contains an offset. The length of the offset cheek, dimension "Z", should be 2 1/2 times the offset. Find dimension Z when the offset is 3 1/4", 4 1/2", 5 3/4".

a) 3 1/4" ___________

b) 4 1/2" ___________

c) 5 3/4" ___________



CHEEK PATTERN

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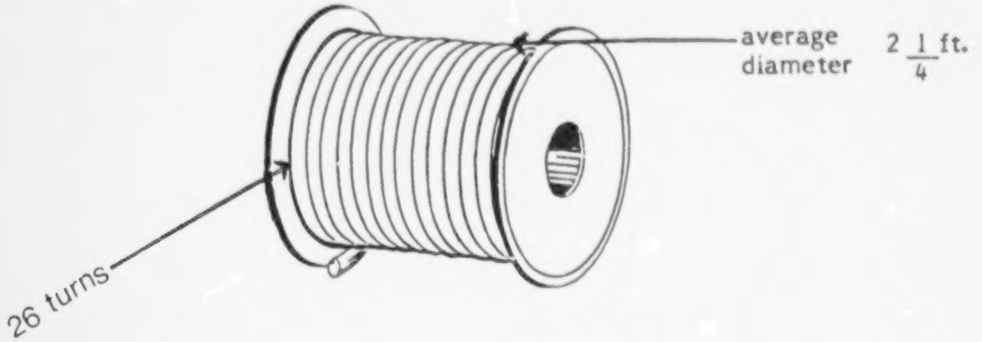
13. The length of tubing in a roll may be estimated to keep from unrolling and measuring the tubing. The roll has 26 turns which were counted. The average diameter was found to be 2 1/4 feet.

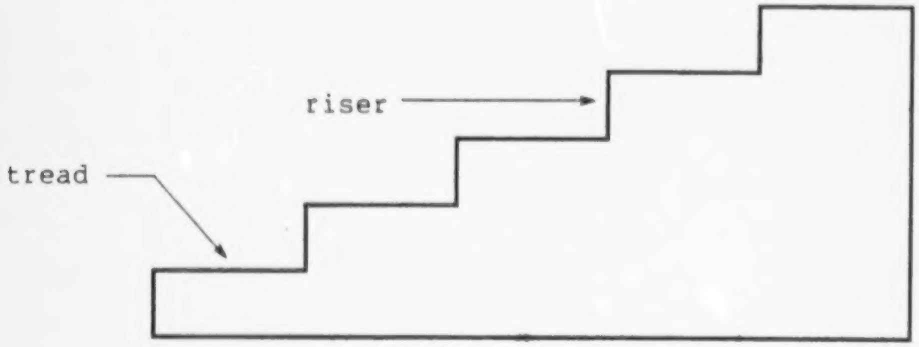
Solve the length as follows:

Average diameter x 3 1/7 x number of turns = length

2 1/4 x 3 1/7 x 26 = ________ approximate length



14. If it takes 1/2 ton of sand to lay 1,000 bricks, how many tons of sand will it take to lay 9,000 bricks?



15. If a flight of brick steps has 5 risers each of which is 7 3/4" high, what is the total height of the flight?

16. Find the height of the brick steps if there were 8 risers each 7 1/4" high.

COMPETENCY #10

Add, subtract, multiply and divide fractions.

PERFORMANCE OBJECTIVE #17

Given any combination of fractions, mixed numbers and whole numbers, find the quotient.

INSTRUCTIONAL ACTIVITIES

Sample Item

How many 2 1/2 ft. boards can be cut from a board 12 1/2 feet long?

Solution: 12 1/2 :- 2 1/2 = 5

Notes

Division of fractions, whole numbers, and mixed numbers is a skill needed by technicians to determine the cost of portions of a larger quantity and to determine the number of items that can be made from a given piece of material. Calculations made before taking action may save time, effort and resources.

Students must know how to change feet to inches to do these applications. Note that whole number answers are frequently needed.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 42-44, 369.

EVALUATION

1. If pitch = 1/number of threads per inch, what is the pitch of a screw having 7 1/4 threads per inch?
2. How many pieces 1 15/16 inches long can be cut from a strip of sheet metal 13 1/8 inches long?
3. A carpenter lays 12 1/2 squares of shingles in 5 1/2 days. What is the average number of squares laid in one day?
4. 2 1/8 ÷ 3/4 =

ANSWERS TO EVALUATION

1. Pitch: 4/29
2. 6 pieces
3. 2 3/11 squares
4. 2 5/6

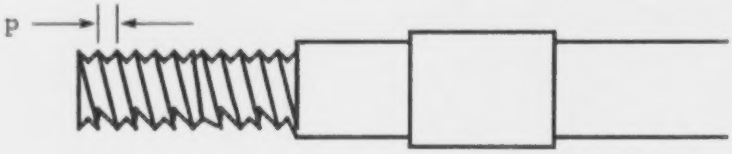
ANSWERS TO APPLICATIONS

1. a) 1/10"
   b) 2/9"
   c) 2 2/3 threads per inch
2. 5
3. 28
4. 24 1/2 volts
5. 36
6. 6
7. 4
8. 36
9. 13
10. 153
11. 6
12. 48
13. 8

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #17

Performance Objective #17: Given any combination of fractions, mixed numbers and whole numbers, find the quotient.

1. The pitch of a screw thread is the distance between the corresponding points of any two adjacent screw threads.



Since threads are always referred to as being so many to the inch, it follows that Pitch = 1 ÷ number of threads per inch, or Pitch = 1/no. of threads per inch.

From this, it follows that the number of threads per inch = 1 :- Pitch. To illustrate: what is the pitch of a screw having 8 threads per inch?

P = 1/8 = 1/8"

What is the number of threads per inch, if the screw has a pitch of 3/16?

No. of threads = $\frac{1}{\text{Pitch}}$ = 1 ÷ 3/16 =

1 x 16/3 = 5 1/3

5 1/3 threads per inch

a) Find the pitch of a screw having 20 threads per inch.

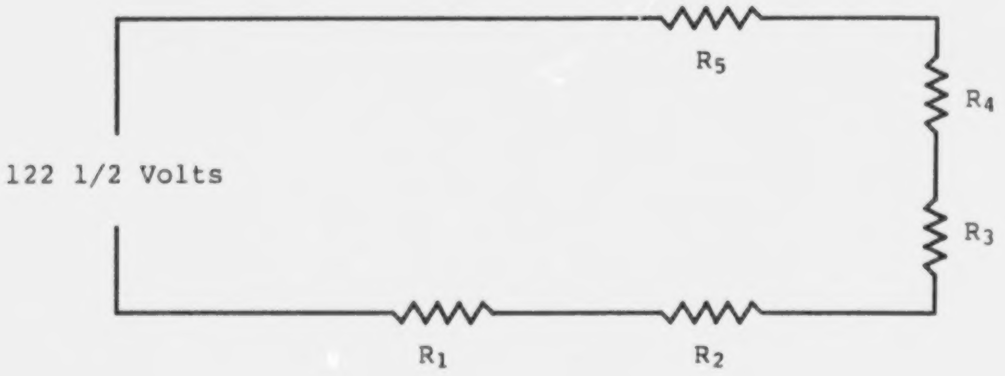
b) Find the pitch of a screw having 4 1/2 threads per inch.

c) Find the number of threads per inch of a screw having a pitch of 3/8".

2. A can of R-12 refrigerant contains 64 1/2 oz. Refrigerators are being repaired. Each one requires 12 1/4 oz. of refrigerant to be fully and correctly charged. How many refrigerators can be charged?

3. A strip of sheet metal is 49 1/8 inches long. How many pieces 1 3/4 inches long can be cut from the strip?

4. If 122 1/2 volts are distributed equally over each of the resistors shown below, find the average number of volts per resistor.



5. A 15-foot long piece of angle iron is in stock. How many 5-inch pieces can be cut from it?

6. How many 2 1/4 inch long pieces may be cut from a 14 3/4 inch length of channel iron?

7. A piece of key stock 15 1/4 inches long is in stock. How many keys 3 3/4 inches long may be cut from this stock?

8. How many pieces of tile 3/4 ft. long are required to cover a strip 27 feet long?

9. How many bricks 7 1/2 inches long can be laid in a row 97 1/2 inches long?

10. How many pieces of 4/8 inch plywood are there in a stack 8 feet high?

11. Find the number of risers 7 1/4" high that will be needed for a flight of brick steps that are 3' 7 1/2" high.

12. How many bricks are needed to lay a rowlock course 11' if the width of the rowlock and mortar joint is 2 3/4"?

13. If a laborer can excavate 3 1/4 cubic yards of soil in one hour, how many hours will it take the laborer to remove 26 cubic yards of soil for footings?

COMPETENCY #10

Add, subtract, multiply, and divide fractions.

PERFORMANCE OBJECTIVE #18

Given any combination of fractions, mixed numbers and whole numbers, perform any of the four basic math operations.

INSTRUCTIONAL ACTIVITIES

Sample Item

In building construction, floor joists and studs are frequently spaced 16 inches on center. How many of either one would be utilized in the length 42' 8"?

1. How many inches are in 42' 8"?
2. How many feet are in 16 inches?
3. How many are needed?

Solution #1 (12" = 1 ft.): (42 x 12) + 8 = 512"
512" ÷ 16" = 32 pieces

Solution #2 (12" = 1 ft.): 16/12 = 1 1/3 ft.: 42'8" = 42 2/3 ft.

Solution #3 (16" = 1 1/3 ft.): 42 2/3' ÷ 1 1/3' =
128/3 x 3/4 = 32 pieces

Notes

Students should learn the basic units, abbreviations, and equivalents of the English system. Students should be aware that English linear measurements are more commonly used by laymen in the different trades. The student should learn the order of mathematical operations -- brackets and parentheses; multiplication or division in order; and then, addition or subtraction. A unit on ordering of operations will be taught later in the curriculum.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 45.

EVALUATION

1. In constructing steps we have a rise of 8'. If a set of steps has 12 risers, how high will each riser be?

2. A mortar joint is 3/8 inch thick. What is the total thickness of 27 mortar joints?

3. An axle shaft has dimensions of 21 inches, 15/16 inches, and 7 7/8 inches. How long is the axle shaft?

4. A 9 5/16 inch long piece of bar stock is cut from a piece of stock 16 1/2 inches long. What is the length of the remaining bar stock?

ANSWERS TO EVALUATION

1. 8 in.
2. 10 1/8 in.
3. 29 13/16 in.
4. 7 3/16 in.

ANSWERS TO APPLICATIONS

1. 300 in.
2. 12
3. 286.13 cu. in.
4. 6' 11"
5. 3 3/4"
6. 3"
7. 4,125 gallons
8. 2633 1/3 sq. ft.
9. 530
10. $21,840

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #18

Performance Objective #18: Given any combination of fractions, mixed numbers and whole numbers, perform any of the four basic math operations.

1. A carpenter is using a 25 ft. steel tape. How many inches are on the tape?

2. How many pieces of stock 2 3/4" long can be cut from a piece 33 inches long?

3. A cylinder is 4 1/2 in. in diameter and 18 in. long. Find the volume of the cylinder in cu. in. using the formula $v = \Pi rrh$ where $\Pi = 3.14$.

4. A cabinetmaker needs the following pieces of molding: 1 piece 1'6", 2 pieces 10" and 3 pieces 1'3". How many linear feet of molding must he buy?

5. How wide a board may be cut from a piece 11 1/2 in. wide if 3 are needed and the saw kerf is 1/8 in. wide? (Hint: Make only 2 cuts.)

6. A steel beam is 1/4 of a yard long. You only need 1/3 of its length to level a piece of machinery. How long is the piece you need in inches?

7. One cu. ft. holds 7 1/2 gallons of water. How many gallons does a tank 550 cu. ft. hold?

8. A square of shingles covers 100 sq. ft. of roof area. How many sq. ft. can be covered by 26 1/3 squares?

9. A loader used in excavation has a capacity of 1 3/4 cu. yds. How many loads would be needed to excavate a building site where 25,000 cu. ft. need to be moved? (Hint: 27 cu. ft. = 1 cu. yd.)

10. What will be the cost of brick on a construction job where 7 1/2 bricks per sq. ft. of surface area are used by the estimator and there are 26,000 sq. ft. to be bricked at $112 per thousand?

COMPETENCY #11

Make conversions within the English system of measurement.

PERFORMANCE OBJECTIVE #19

Given a linear measure in English units, write an equivalent measure in another unit.

INSTRUCTIONAL ACTIVITIES

Sample Item

The woodworking instructor wishes to know how many 3-inch pieces may be cut from a board 6 1/2 feet long.

1. How many inches are in 6 1/2 feet?
2. How many pieces may be cut?

Solution (12" = 1 ft.): 6 1/2 x 12 = 78 inches
78" ÷ 3" = 26 pieces

Notes

Students should memorize basic units and their equivalents. Different trades work with different dimensions, but most use feet and inches. Students should know that linear refers to a measure of length. Be sure students know one abbreviation for commonly used units. This is an appropriate time to work with operations with measurements.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 46-47.

EVALUATION

1. 8 1/3 yds. = ________ ft.
2. 6 ft. = ________ in.
3. 3 yds. 1 ft. 4 in. = ________ in.
4. 86 in. = ________ ft. ________ in.

ANSWERS TO EVALUATION

1. 25 ft.
2. 72 in.
3. 124 in.
4. 7 ft. 2 in.

ANSWERS TO APPLICATIONS

1. 72 inches
2. 4 feet 8 inches
3. 3 feet 6 1/4 inches
4. a) 48 in.
   b) 66 in.
   c) 3 1/4 ft.
   d) 29 2/3 yds.
   e) 15 ft.
   f) 2 1/3 yds.
   g) 2 7/18 yds.
   h) 12,700 microns
5. 252 inches
6. 24 feet
7. 3 ft.
   36 in.

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #19

Performance Objective #19: Given a linear measure in customary units, write an equivalent measure in another unit.

1. A bricklayer is using a six-foot rule. How many inches are on this rule?

2. If a mason measures the width of an opening and finds it to be 56 inches, how many feet and inches does this represent?

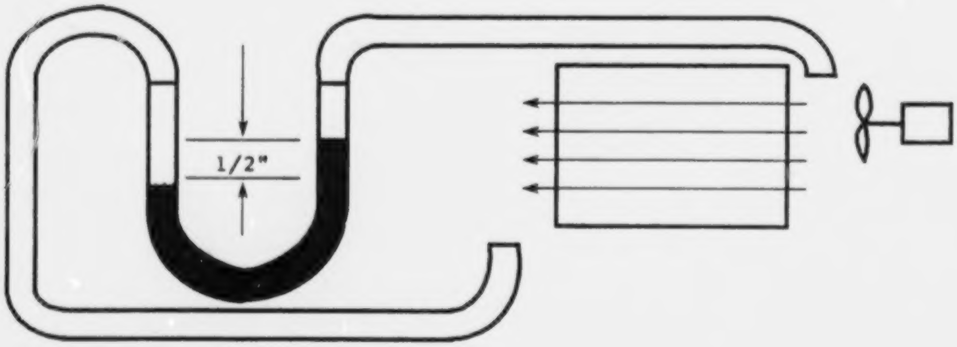
3. A mason measures the distance from a foundation wall to the bottom of a windowsill and finds the distance to be 42 1/4 inches. How many feet and inches is that?

4. Given: Linear Measurement Conversion

   12 in = 1 ft.
   3 ft. = 1 yd.
   25,400 microns = 1 in.

   Change the following units of measure.

   a) 4 ft. = ________ in.
   b) 5 1/2 ft. = ________ in.
   c) 39 in. = ________ ft.
   d) 89 ft. = ________ yds.
   e) 5 yds. = ________ ft.
   f) 7 ft. = ________ yds.
   g) 86 in. = ________ yds.
   h) A "U" tube manometer reads one-half inch of mercury positive pressure. What would the reading be in microns?



5. A piece of 1-inch cold rolled steel in stock is 21 feet long. How many inches are in this piece?

6. If a steel tape measure is 288 inches long, how many feet are in the tape?

7. A yardstick has how many feet and how many inches?

COMPETENCY #12

Find the perimeter of polygons using English units.

PERFORMANCE OBJECTIVE #20

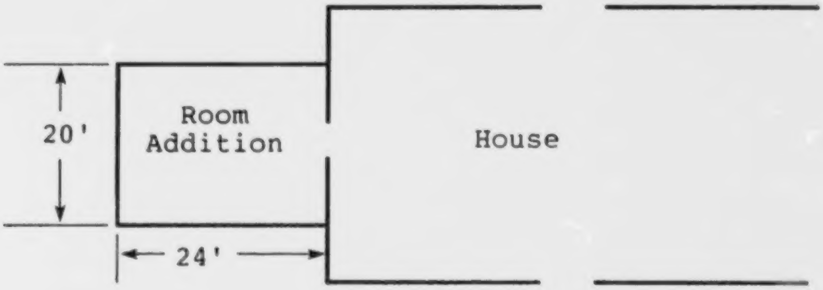
Given a polygon with dimensions in English units, find the perimeter.

INSTRUCTIONAL ACTIVITIES

Sample Item

The Smith family is building a new room onto their home. The size of the room is 20 x 24 ft. How many feet of baseboard will it take to go around the room? (Disregard door opening.)

$p = (2 \times l) + (2 \times w)$ $2 \times 20 = 40$, $2 \times 24 = 48$, $40 + 48 = 88$ ft.



Notes

Perimeter frequently must be found before quantities of materials can be ordered.

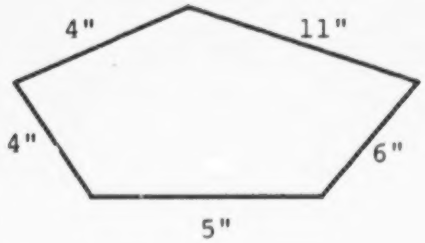
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 73-75, 99-101.

EVALUATION

1. Find the perimeter of a square room whose sides are 14 ft. each.
2. What is the perimeter in yards of a rectangle 29 ft. by 32 ft.?

3. Find the perimeter.



4. At the curb line, each side of a city block is 330 ft. If you go around the block, how far have you walked?

ANSWERS TO EVALUATION

1. 56 ft.
2. 40 yds. 2 ft.
3. 30"
4. 1,320 ft.

ANSWERS TO APPLICATIONS

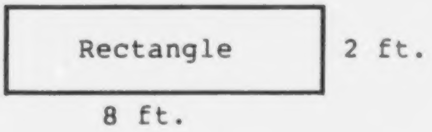
1. 20 ft.
2. 48 in.
3. 52"
4. 10 3/4 in.
5. 31 ft. 6 in.
6. 43 1/2 ft.
7. a) 24"
   b) 6"
   c) 33"
8. 88'
9. 664 ft.
10. 74 ft.
11. 4,160 ft.
12. a) 6"
    b) 6 1/4"
    c) 6"

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #20

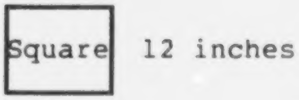
Performance Objective #20: Given a polygon with dimensions in English units, find the perimeter.

The perimeter of a polygon is the sum of the length of the sides. Find the perimeters of the following polygons.

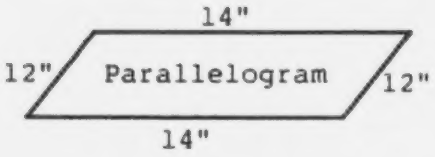
1.


Rectangle
2 ft.
8 ft.

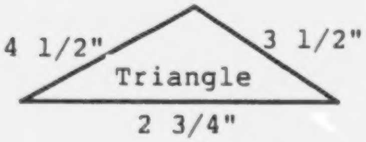
2.


Square
12 inches

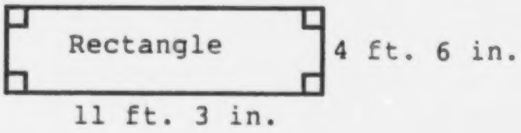
3.


14"
12"
Parallelogram
12"
14"

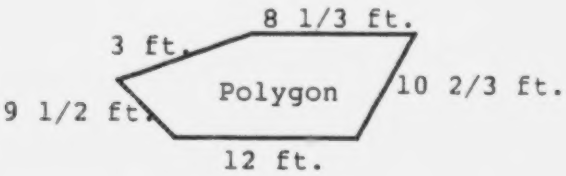
4.


4 1/2"
3 1/2"
Triangle
2 3/4"

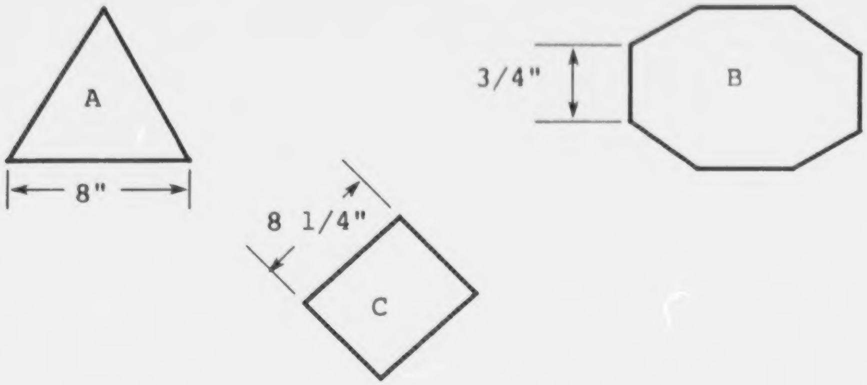
5.


Rectangle
4 ft. 6 in.
11 ft. 3 in.

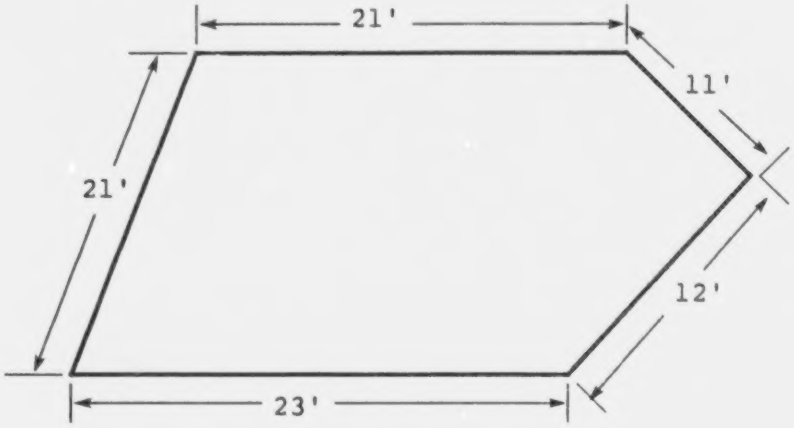
6.


8 1/3 ft.
3 ft.
Polygon
10 2/3 ft.
9 1/2 ft.
12 ft.

7. These 3 shapes are cut from 1/4 inch steel plate. Find the perimeter of each. (Each figure is a regular polygon.)



8. Find the perimeter of this work area.



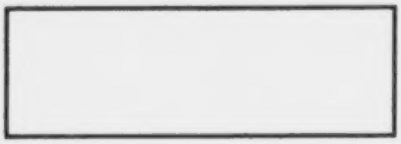
9. Find the perimeter of a rectangular plot of land 112 ft. wide and 220 ft. long.

10. How many linear feet of crown molding is required for a room 16' x 21'?

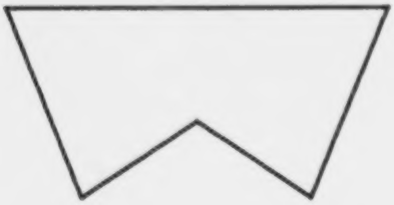
11. A new area has been added to the city park with outside dimensions of 1,040 ft. x 1,040 ft. What is the distance, in feet, around it?

12. Use your ruler to measure the sides in each of the following figures to the nearest quarter inch, then give the perimeter. Note: Answers will vary because of changes which occur during printing.

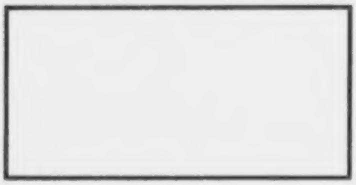
A.



B.



B.



COMPETENCY #13

Read a metric ruler.

PERFORMANCE OBJECTIVE #21

Given a line segment and a ruler, measure the length of the segment to the nearest millimeter.

INSTRUCTIONAL ACTIVITIES

Sample Item

How long is it from point A to point B in millimeters?

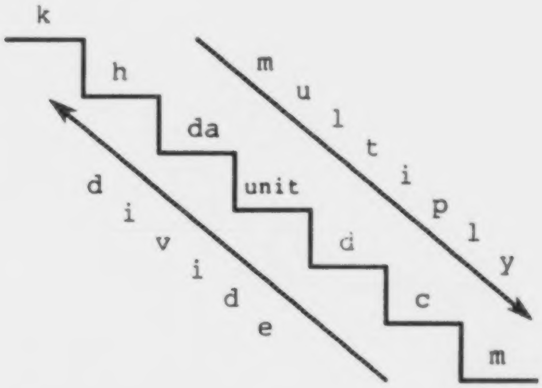
118 mm

A. B.

Notes

Anyone doing sheet metal work routinely uses a steel ruler to lay out patterns. Accuracy is very important. Practice to develop skills in measuring may be obtained by determining lengths of lines of scale drawings of sheet metal patterns.

General: After students begin using a metric ruler, they can be given instructions on changing from one metric unit to another. Stress moving decimals using a model such as the following:



Conversion is handled in depth later, so do not overdo at this time. Multiplying by powers of ten is accomplished by moving the decimal to the right. To divide, move the decimal to the left.

Students will find the basic unit of length spelled both meter and metre. Stress that m, cm, mm, etc. are symbols and not abbreviations. The symbols are not followed by periods or s's for plural.
Measurements are typically given in one unit, not mixed. For example, the length above could be written in 122 mm or 12.2 cm but not 12 cm 2 mm. Decimeters are seldom used except as a reference.

REFERENCE TO TEXT

None

EVALUATION

Given the length of each of these segments to the nearest millimeter.

1. ____

2. ________

3. ______________

4. ____________________

ANSWERS TO EVALUATION

1. 10 mm
2. 20 mm
3. 35 mm
4. 49 mm

ANSWERS TO APPLICATIONS

1. a) 104 mm
   b) 37 mm
   c) 98 mm

2. a) 79 mm
   b) 59 mm
   c) 113 mm
   d) 103 mm
   e) 83 mm
   f) 35 mm
   g) 108 mm
   h) 88 mm
   i) 103 mm

3. AJ = 52 mm
   AC = 72 mm
   AH = 27 mm
   CF = 28 mm
   JK = 28 mm
   JF = 76 mm

Note: Answers may vary due to measuring instruments or alterations occurring during printing.

4. AA = 36 mm
   AB = 15 mm
   BC = 51 mm
   AC = 67 mm
   CD = 5 mm
   AD = 73 mm

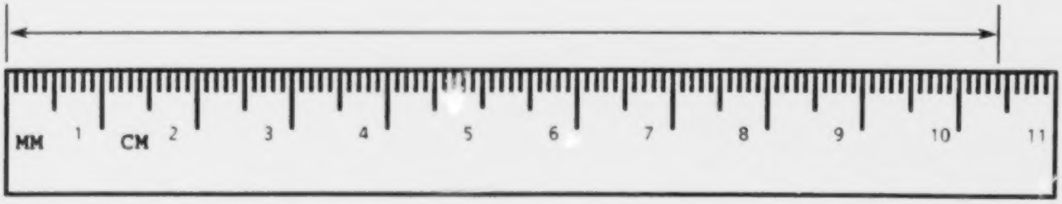
5. AB = 25 mm
   BC = 5 mm
   AD = 34 mm
   CH = 56 mm
   DE = 56 mm
   FG = 25 mm

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #21

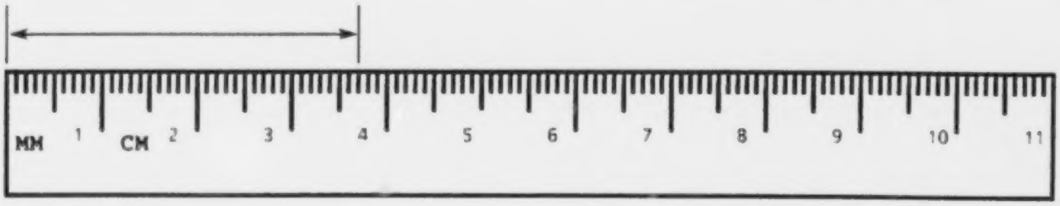
Performance Objective #21: Given a segment and a ruler, measure the length of the segment to the nearest millimeter.

1. Read each of the following metric rulers at the mark indicated. Give the reading to the nearest millimeter.

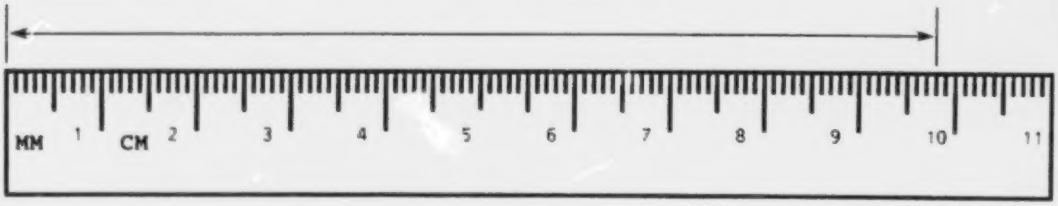
a)


MM
1
CM
2
3
4
5
6
7
8
9
10
11

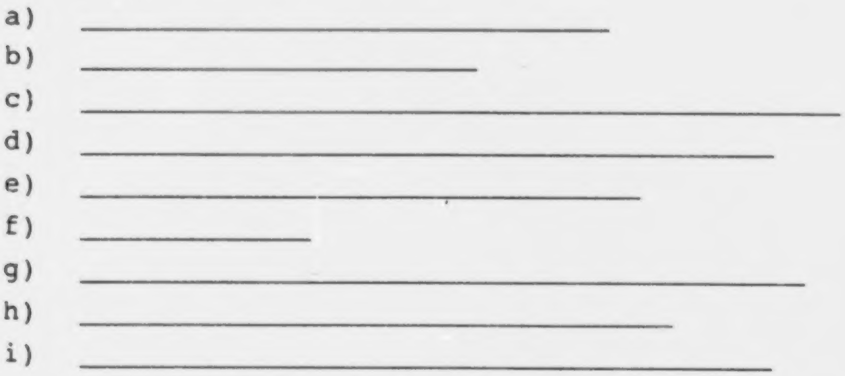
b)


MM
1
CM
2
3
4
5
6
7
8
9
10
11

c)


MM
1
CM
2
3
4
5
6
7
8
9
10
11

2. Using a ruler, determine the length of each line segment to the nearest millimeter.



3. Sheet metal patterns are used to assist in laying out fittings. The patterns are not dimensioned so they can be used to make any size fitting.

On the given sheet metal patterns, lengths of lines are identified by letters, for example: AA or AB.

Measure the line segments identified below and record the length to the nearest millimeter.

AJ = ________

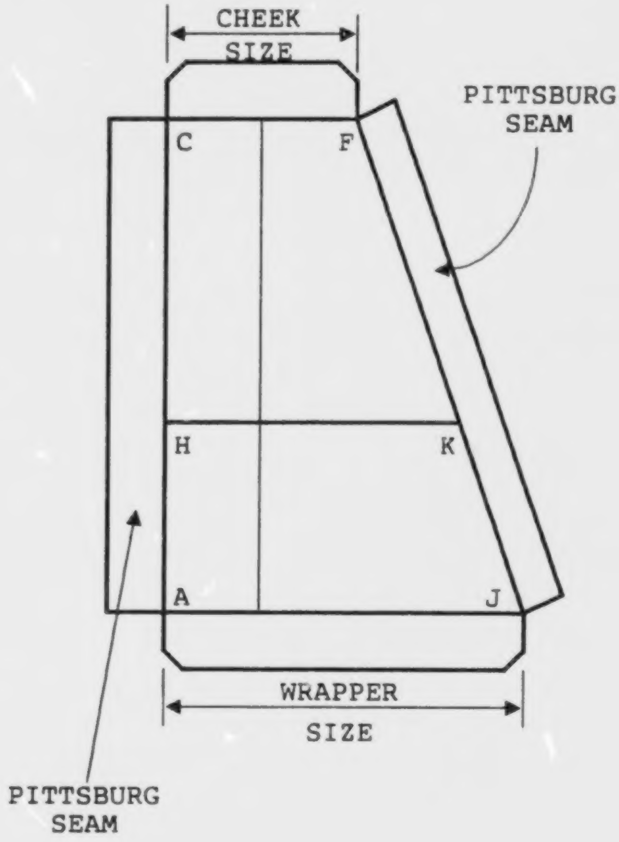
AC = ________

AH = ________

CF = ________

JK = ________

JF = ________


CHEEK
SIZE
PITTSBURG
SEAM
C
F
H
K
A
J
WRAPPER
SIZE
PITTSBURG
SEAM

4. Measure each segment to the nearest millimeter.

AB = ___________

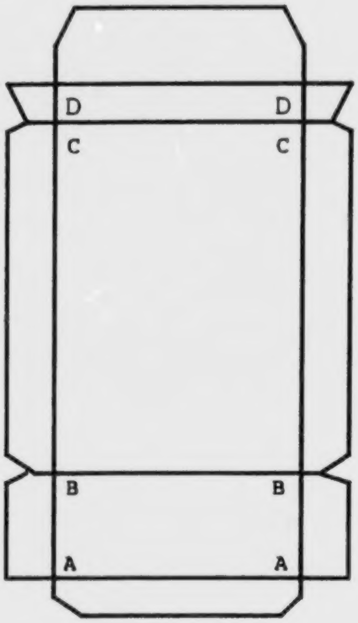
BC = ___________

AD = ___________

CH = ___________

DE = ___________

FG = ___________



5. Measure each segment to the nearest millimeter.

AA = ___________

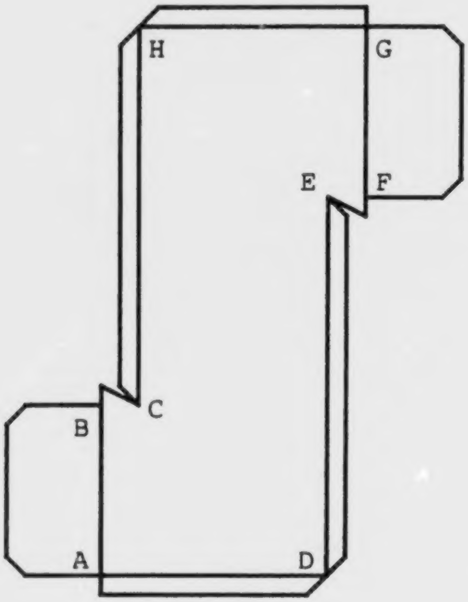
AB = ___________

BC = ___________

AC = ___________

CD = ___________

AD = ___________



COMPETENCY #14

Read and write decimals.

PERFORMANCE OBJECTIVE #22

Given a list of decimal fractions in numerical form and a list in word form, match equivalent forms.

INSTRUCTIONAL ACTIVITIES

Sample Item

.001 is one thousandth

Notes

General: In some trades, all decimals are read as thousandths regardless of how they are written. For example, in machine shop, 0.1 is read as one hundred thousandths.

Students must be able to hear a measurement and write it accurately. For this reason, a worthwhile activity is to call out lists of decimals and have the students write them. Students should know to read the decimal point as "and" -- not point.

REFERENCE TO TEXT

None

EVALUATION

Match the written expression with the numerical form:

1.	one hundredth	a)	0.101
2.	one tenth	b)	0.1
3.	one thousandth	c)	0.01
4.	one hundred one thousandths	d)	0.001
		e)	0.11

ANSWERS TO EVALUATION

1. c
2. b
3. d
4. a

ANSWERS TO APPLICATIONS

1. a) 0.76
   b) 0.405
   c) 0.0064
   d) 0.00094
   e) 0.4
2. a) 4
   b) 8
   c) 1
   d) 2
   e) 7
   f) 5
   g) 6
3. 1) d
   2) a
   3) e
   4) b
   5) c

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #22

Performance Objective #22: Given a list of decimal fractions in numerical form and a list in word form, match equivalent forms.

1. In solving problems, written numbers must expressed in numerical form. Express the following written decimals in numerical form.

   a) Seventy-six hundredths

   b) Four hundred five thousandths

   c) Sixty-four ten-thousandths

   d) Ninety-four hundred-thousandths

   e) Four tenths

2. Column I lists decimal fractions in word form. Column II lists decimal fractions in numerical form. Give the number of the numerical form that matches the word forms.

COLUMN I	COLUMN II
a) Six hundredths	1. 0.047
b) Four and twenty-seven thousandths	2. 0.0007
c) Forty-seven thousandths	3. 0.7470
d) Seven ten-thousandths	4. 0.06
e) Seven thousand forty-seven ten-thousandths	5. 34.654
f) Thirty-four point six five four	6. 0.347
g) Three hundred forty-seven thousandths	7. 0.7047
	8. 4.027
	9. 0.60

3. Match the decimal fractions in Column II to the word numbers in Column I.

COLUMN I	COLUMN II
1. Twenty-eight hundredths	a) 0.0028
2. Twenty-eight ten-thousandths	b) 0.2800
3. Two and eight thousandths	c) 2.80
4. Two thousand eight hundred ten-thousandths	d) 0.28
5. Two and eighty hundredths	e) 2.008

COMPETENCY #15

Compare decimals.

PERFORMANCE OBJECTIVE #23

Given two decimal fractions, tell which is larger or state that they are equivalent.

INSTRUCTIONAL ACTIVITIES

Sample Item

Replace the ? with <, > or = .

0.81 ? 0.081 (ans: >)

Notes

General: An easy way to compare decimals is to list them vertically lining up the decimal points. Add enough zeros at the end to make the numbers have the same number of digits. Comparison is then made of the same place value.

Metal, wire, cable and small copper tubing are used in many trade areas. These items are identified by decimal fractions. Students must be able to compare correctly various decimal sizes.

REFERENCE TO TEXT

None

EVALUATION

Replace the ? with <, >, or = .

1. 0.101 ? 0.011
2. 0.6 ? 0.125
3. 0.041 ? 0.421
4. 0.3 ? 0.300

ANSWERS TO EVALUATION

1. >
2. >
3. <
4. =

ANSWERS TO APPLICATIONS

1. a) H
   b) E
   c) 6
2. 0.035
3. b
4. b
5. a) <
   b) =
   c) <
   d) =
   e) >
   f) <

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #23

Performance Objective #23: Given two decimal fractions, tell which is larger or state that they are equivalent.

1. Drill bits are identified by letter (Z-A) and by number (1-80). Each letter drill and number drill is assigned a decimal fraction size. Compare the following drills. Which is the larger in each pair?

   a) A is 0.234 compared to H is 0.358.

   b) E is 0.25 compared to 5 is 0.2055.

   c) 6 is 0.24 compared to 73 is 0.024.

2. Tubing is identified by outside diameter and is made in various wall thicknesses for different strengths.

   1/8' tube comes in two wall thicknesses: 0.028 and 0.035. Which is larger?

3. A 1/8 or 0.125 inch hole is to be drilled and then counter bored with a larger drill. Which drill would you use to counter bore?

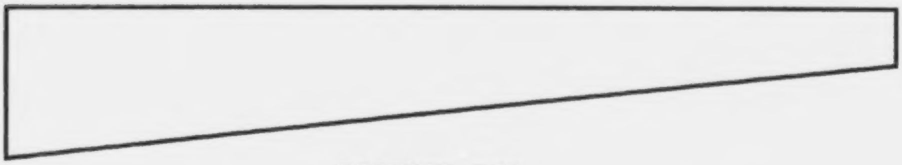
   a) 0.109375

   b) 0.15625

4. When given the dimensions of a tapered pin, the machinist must determine which is the larger dimension.

   a) dimension 1.505 in.

   b) dimension 1.550 in.



TAPERED PIN

136

5. Using the symbols >, < and =, make the following statements true.

a) .06 ? .60

b) 1.01 ? 1.010

c) .005 ? .050

d) 0.3 ? 0.30

e) 0.018 ? 0.0018

f) 0.005 ? 0.10

COMPETENCY #16

Convert decimals to common fractions and vice versa.

PERFORMANCE OBJECTIVE #24

Given a list of common fractions and a list of decimal fractions, match equivalent forms.

INSTRUCTIONAL ACTIVITIES

Sample Item

```
3/4 = ? a)  .60     (ans:  b)
        b)  .75
        c)  .66
```

Notes

Common fractions and decimals are frequently mixed in the same problem, making conversion from one form to the other mandatory. Rounding decimals is also an important skill at this time.

In doing repair work, parts are replaced. The original specifications may have been stated in decimal form and the replacement in common fraction form.

When fabricating items, specifications may be given in either decimal or common fraction form or a combination of both.

The student must be able to match equivalent forms.

The rafter tables on the framing square used by carpenters show the rafter length per foot of run. Decimals are used instead of common fractions. A carpenter should be able to read decimal equivalents to 1/16th of an inch.

REFERENCE TO TEXT

<u>CAREER MATHEMATICS</u>, page 363, skill 11.

EVALUATION

Match the common fractions on the left with the decimal equivalent on the right. (Decimals are rounded to the nearest ten thousandths.)

1. 1/64
2. 3/4
3. 1/8
4. 3/16
5. 5/8
6. 1/2

a) 0.1250

b) 0.0156

c) 0.5000

d) 0.7500

e) 0.6250

f) 0.1875

g) 0.5625

ANSWERS TO EVALUATION

1. b
2. d
3. a
4. f
5. e
6. c

ANSWERS TO APPLICATIONS

1. a) 6
   b) 1
   c) 7
   d) 2
   e) 4
   f) 3
   g) 5

2. a) 0.8125
   b) 0.0469
   c) 0.3281
   d) 0.6563
   e) 0.250
   f) 0.375

3. a) 0.265625
   b) 0.375
   c) 0.625
   d) 0.3125
   e) 0.4375
   f) 0.15625

4. a) 0.4219
   b) 0.09375
   c) 0.0625
   d) 0.25
   e) 0.375
   f) 0.5

5. 0.67

6. 0.6875

7. 0.83 1/3

8. 0.405

9. 75/100 = 3/4

10. 80/100 = 4/5

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #24

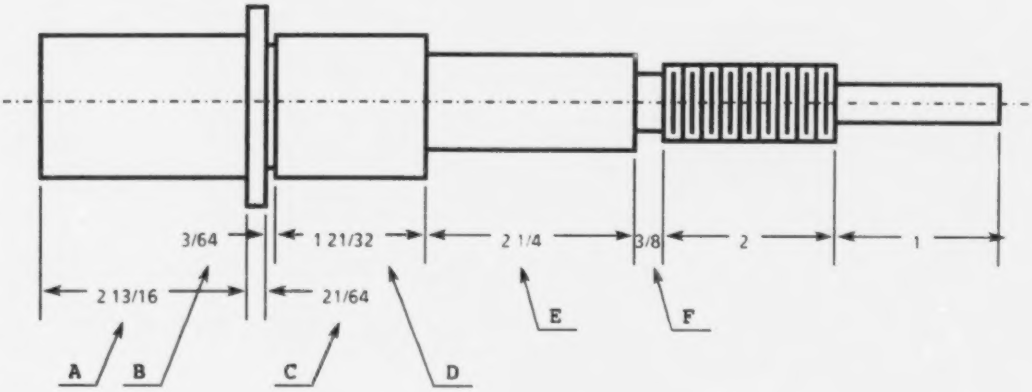
Performance Objective #24: Given a list of common fractions and a list of decimal fractions, match equivalent forms.

1. Match the list of common fractions to the list of decimal fractions.

   a) 1/8
   b) 1/4
   c) 3/8
   d) 1/2
   e) 3/4
   f) 2/3
   g) 1/5

   1. 0.250
   2. 0.500
   3. 0.66 2/3
   4. 0.750
   5. 0.200
   6. 0.125
   7. 0.375

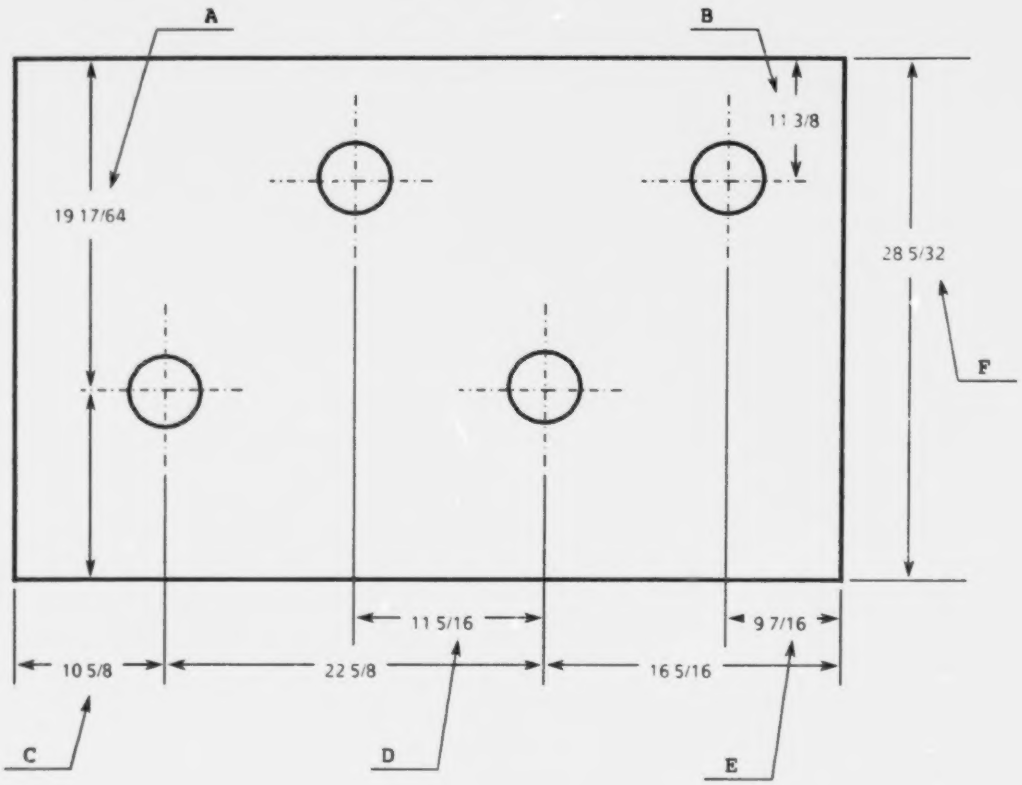
2. Match the common fraction with the correct decimal fraction below. Consider the fraction portion only.



0.250
0.3125
0.328
0.375
0.6563

0.6875
0.8125
0.0938
0.6563
0.0469

3. Match the common fraction with the decimal fraction by choosing the decimal fraction from the list below. Consider the fraction portion only.

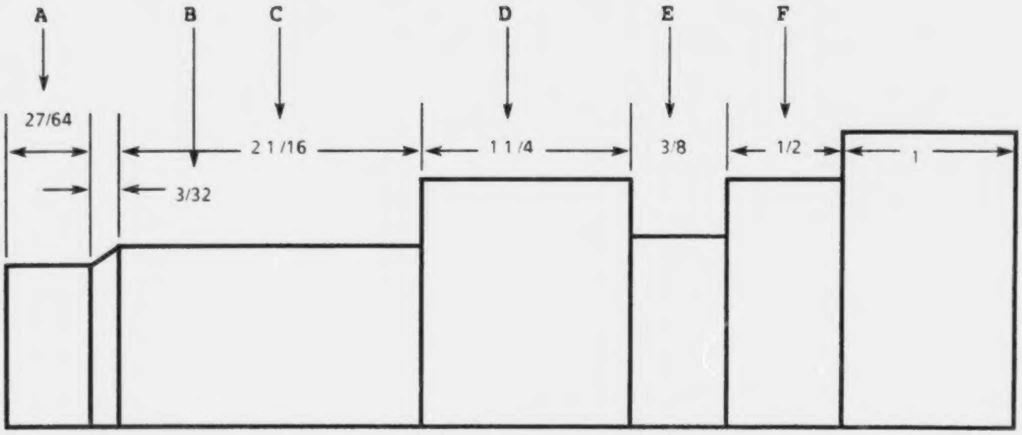

A
B
11 3/8
19 17/64
28 5/32
F
11 5/16
9 7/16
10 5/8
22 5/8
16 5/16
C
D
E

0.0937
0.15625
0.265625
0.3125
0.375
0.4375
0.500
0.625

4. Match the common fraction with the decimal fraction by choosing the decimal fraction from the list below. Consider the fraction portion only.

0.03125
0.0625
0.09375
0.125
0.1875
0.25

0.3125
0.375
0.4219
0.5
0.625



5. What decimal part of a dollar is 67 cents?

6. What decimal fraction of a pound is 11 ounces?

7. 120 square inches is what decimal fraction of a square foot?

8. Change 700 cubic inches to a decimal fraction of a cubic foot. (1 cubic foot = 1728 cubic inches)

9. What fractional part of a dollar is 75 cents?

10. What fractional part of our work is correct when we get a test mark of 80 percent?

COMPETENCY #17

Add, subtract, multiply and divide and round decimals to a designated place value.

PERFORMANCE OBJECTIVE #25

Given two decimal numbers, find the sum.

INSTRUCTIONAL ACTIVITIES

Sample Item

A machinist purchases a new micrometer for $39.50 and a steel ruler for $2.95. How much did he/she spend all together? (ans: $42.45)

Notes

Two major uses of decimals in the vocational world are as money and as measurements. Some time clocks are hundredths clocks.

Sometimes common fractions and decimal fractions are mixed in the same problem.

Even though students use calculators frequently, the teacher must be certain that they know to line up decimals for adding and subtracting.

Construction workers use simplified slide rule-type devices for solving problems. Most of these devices display decimals, not common fractions. The student should become familiar with the operations using decimals instead of common fractions.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 358-360, skills 6-8.

EVALUATION

1. One bag of sand weighs 13.82 kilograms. Another bag weighs 21.3 kilograms. How much do they weigh together?
2. It rained three days last week. Find the total rainfall if it rained 1.04 inches Monday, 0.8 inches Tuesday and 0.43 inches Thursday.
3. Add: 63.8 + 5 + 0.31.
4. A repair order had parts listed as $17.83, $9.15 and $36.43. Find the total cost of the parts.

ANSWERS TO EVALUATION

1. 35.12 kg
2. 2.27 inches
3. 69.11
4. $63.41

ANSWERS TO APPLICATIONS

1. $1,771.45
2. $80.84
3. $3,669.15
4. a) 18.198"
   b) 8.904"
   c) 1.014"
5. 5.11
6. 3.046 amperes
7. 9.724 amperes
8. 2.281"
9. 3.093"
10. 111.5 mm
11. 2.375" or 2 3/8'
12. 2.281"
13. 3.09325"
14. 2.2"
15. 12.25'
16. 7.75'
17. 11.015 cubic yards

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #25

Performance Objective #25: Given two decimal numbers, find the sum.

1. A contractor purchased the following equipment: wheel barrow $59.95; mortar hoe $16.50; mortar mixer $1,695. What was the total cost of this equipment?

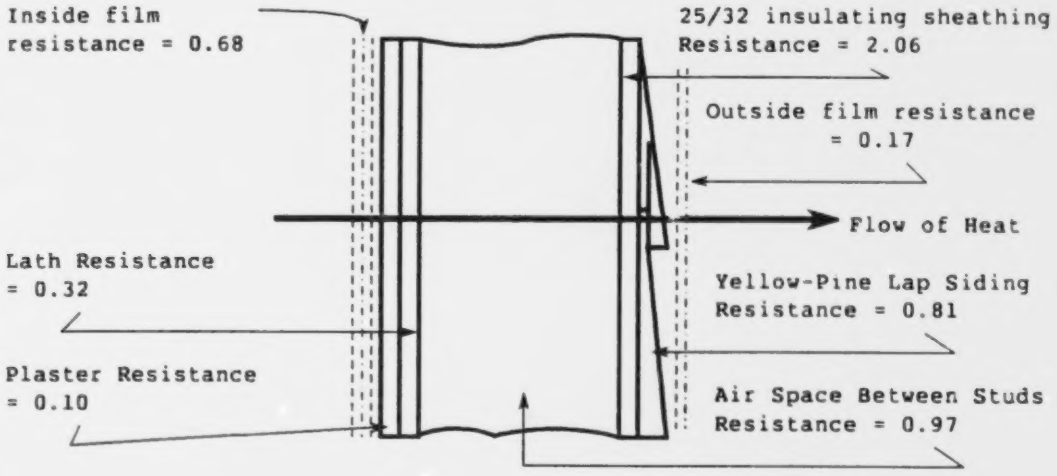
2. A bricklayer's bill was: brick set, $7.50; plasterer's hawk, $13.25; level, $45; pointing trowel, $2.50; brick hammer, $12.59. What was the total bill?

3. A contractor's payroll for one week was: bricklayers - $1,530.40; carpenters - $1,139.85; laborers - $809.50; bookkeeper - $189.40. What is the total amount of the payroll?

4. Given the tolerances below, find the longest length possible.

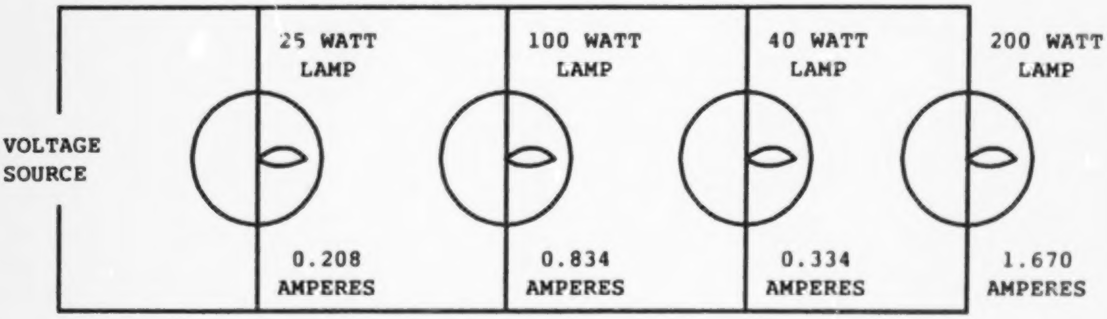
	DIMENSION	TOLERANCE
a)	18.136"	± .062"
b)	8.899"	± .005"
c)	1.002"	± .012"

5. Find the total thermal resistance for the wall construction shown below by adding all the individual resistances.

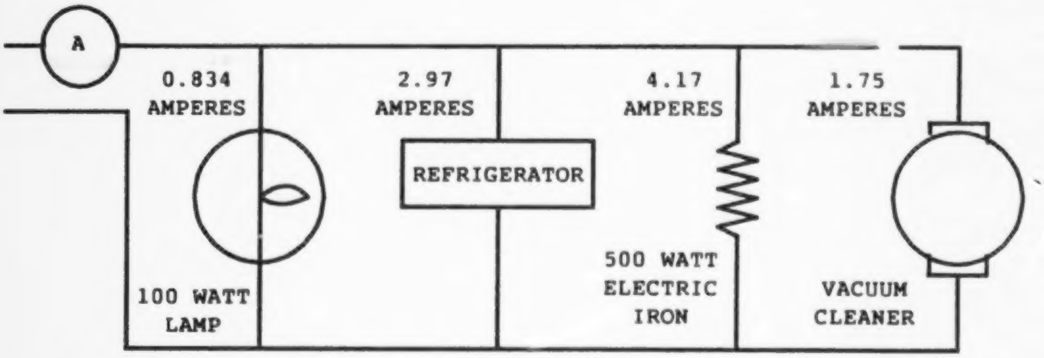

Inside film
resistance = 0.68
25/32 insulating sheathing
Resistance = 2.06
Outside film resistance
= 0.17
Flow of Heat
Lath Resistance
= 0.32
Yellow-Pine Lap Siding
Resistance = 0.81
Plaster Resistance
= 0.10
Air Space Between Studs
Resistance = 0.97

Thermal resistance for wall construction

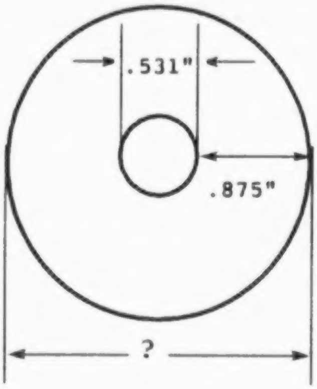
6. If the total current (amperes) in the figure below is equal to the sum of the individual currents, find the total current.


VOLTAGE SOURCE
25 WATT LAMP
0.208 AMPERES
100 WATT LAMP
0.834 AMPERES
40 WATT LAMP
0.334 AMPERES
200 WATT LAMP
1.670 AMPERES

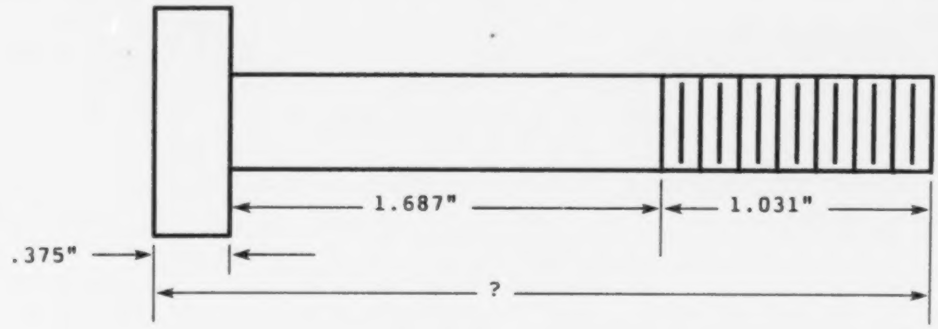
7. The total current in the figure below is measured by the ammeter A. The total current in amperes is distributed in the circuit as shown. Find the total current reading on the ammeter.


A
0.834 AMPERES
100 WATT LAMP
2.97 AMPERES
REFRIGERATOR
4.17 AMPERES
500 WATT ELECTRIC IRON
1.75 AMPERES
VACUUM CLEANER

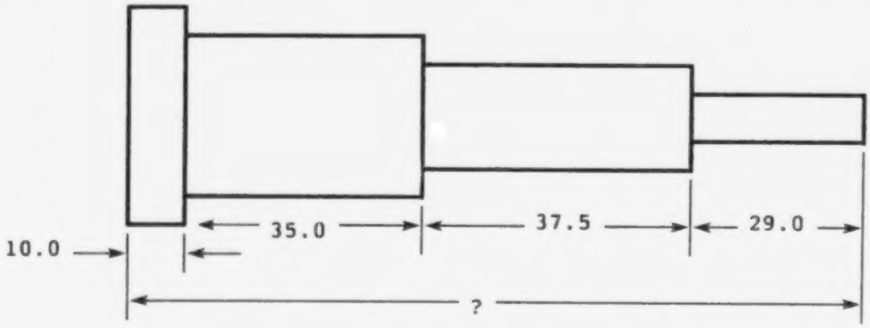
8. What is the diameter of this washer?



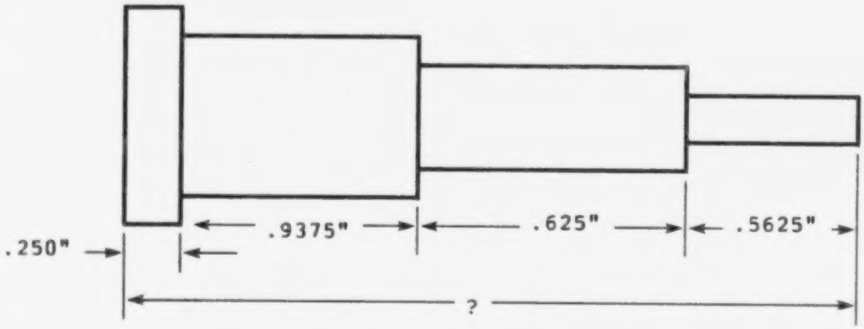
9. What is the length of this bolt?


1.687"
1.031"
.375"
?

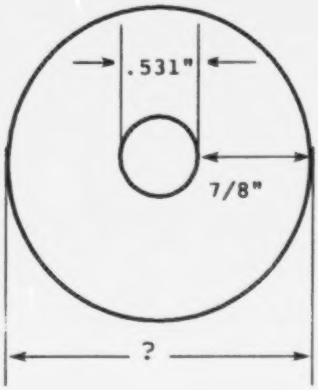
10. Find the overall length in millimeters of this step-pin.


35.0
37.5
29.0
10.0
?

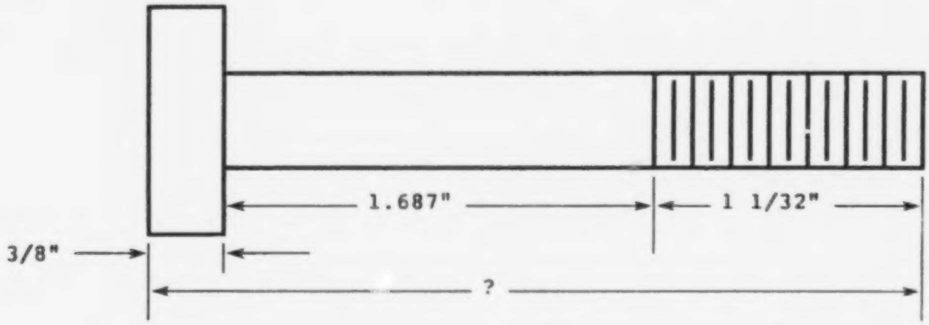
11. The machine shop student must find the overall length of a step-pin. Give answer in decimal form and the common fraction equivalent.


.9375"
.625"
.5625"
.250"
?

12. Give the diameter of the washer in decimal form.



13. Give the length of this bolt in decimal form.



Solve the following problems by addition.

14. What is the total thickness of three metal plates .625", .75" and .825".

15. The length of one piece of lumber is 5.50' and another piece is 6.75'. What is the total length of the two pieces?

16. The Smith family is planning to construct a piece of furniture for their lawn. The plan requires q piece of 2 x 4, 1.5' long, 1 piece 3.75' long and 1 piece 2.25' long. What length piece of 2 x 4 is needed to cut all of these pieces from? Add .25' for waste and kerfs.

17. What is the total amount of concrete required if on footing requires 6.125 cubic yards and another requires 4.89 cubic yards?

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #17

Add, subtract, multiply, divide and round decimals to designated place value.

PERFORMANCE OBJECTIVE #26

Given two decimal numbers, find the difference.

INSTRUCTIONAL ACTIVITIES

Sample Item

Subtract: 8.3" - 1.215" (ans: 7.085")

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 353, 358-360, skills 1, 6-8.

EVALUATION

1. One day an electric meter registered 328.6 KWH. The next day it registered 337.2 KWH. How much electricity was used during the period?
2. At one store a part cost $83.74. The same part cost $69.21 at a second store. How much less was the part at the second store?
3. A tapered pin has a large diameter of 2.03" and a small diameter of 1.624". Find the difference.
4. Subtract: 8 - 3.21

ANSWERS TO EVALUATION

1. 8.6 KWH
2. $14.53
3. 0.406"
4. 4.79

ANSWERS TO APPLICATIONS

1. 0.5625 inches
2. 1.154 ohms
3. 0.75 amperes
4. 0.75"
5. 1.408"
6. .984375"
7. 1.68775"
8. $6,959.60
9. $590.48
10. $120.98
11. 2.129 cm
12. 25 mm
13. 0.9375"
14. 56.2 ft.
15. 0.035"
16. 4.407 lbs.
17. $4,720.27
18. a) 18.074"
    b) 8.894"
    c) 0.990"

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #26

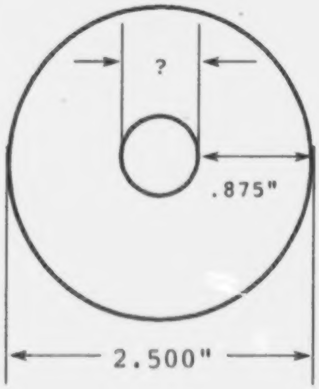
Performance Objective #26: Given two decimal numbers, find the difference.

1. A bearing bushing has an outside diameter (O.D.) of 3.9375 inches and an inside diameter (I.D.) of 3.375 inches. What is the thickness of the wall?

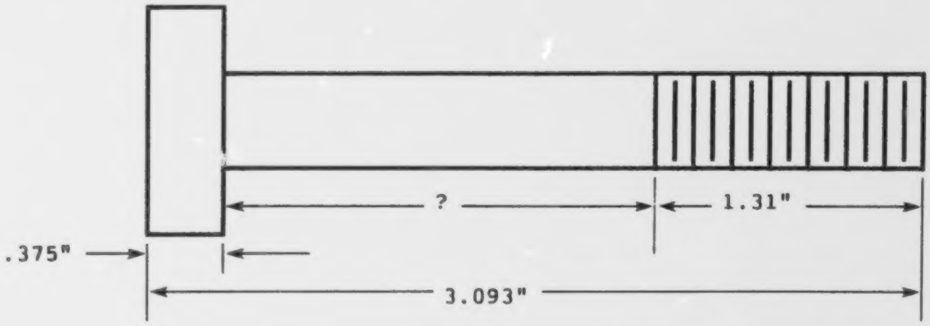
2. The cold resistance of an armature measures 0.096 ohms. After being run for 5 hours, the resistance is 1.25 ohms. What is the difference in the resistance?

3. The field current of a motor is 1.12 amperes at no load. However, when the full load is applied, the current increases to 1.87 amperes. What is the difference in amperes from no load to full load?

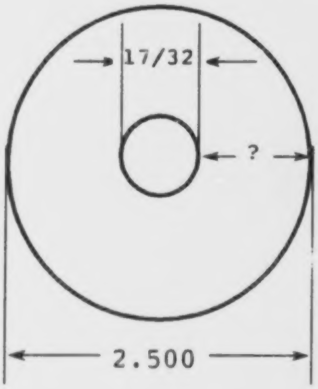
4. What is the diameter of the hole in this washer?



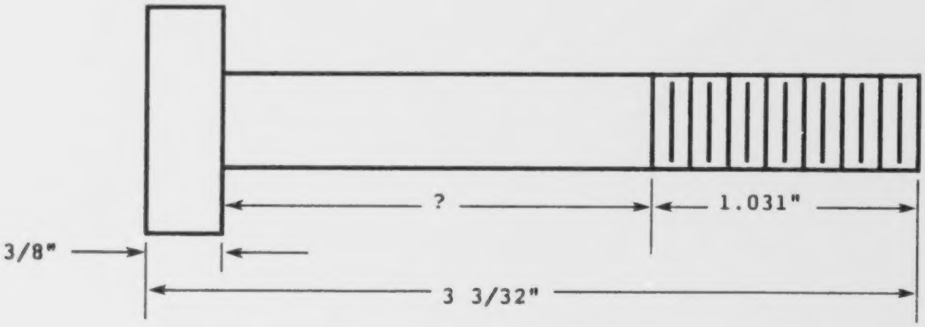
5. What is the body length of this bolt?


?
1.31"
.375"
3.093"

6. What is the body thickness of this washer?



7. What is the body length of this bolt? (Give answer as a decimal number.)


?
1.031"
3/8"
3 3/32"

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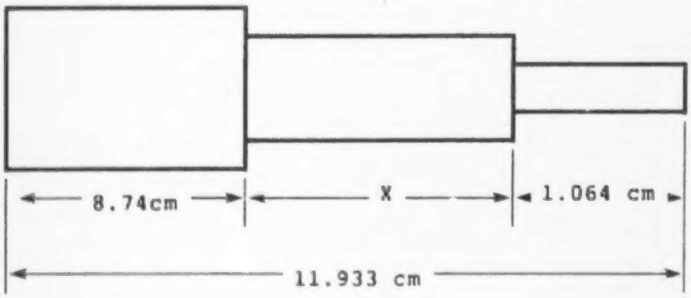
8. A contractor is buying a new truck which costs $11,150.35. The contractor is allowed $4,190.75 for the old truck. How much actual money will the contractor pay for the new truck?

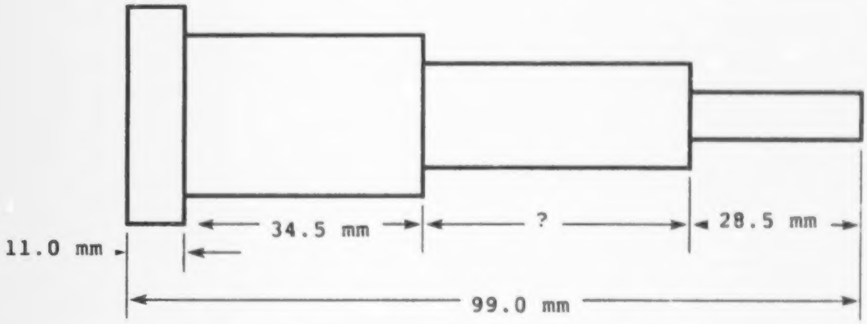
9. A contractor received $1,150 for a job. The material and labor cost $559.52. What was the amount of the contractor's profit?

10. The materials for a rock retaining wall came to $342.50. The labor was $286.52. The contractor received $750.00 for the job. What was the contractor's profit?

11. Find X.

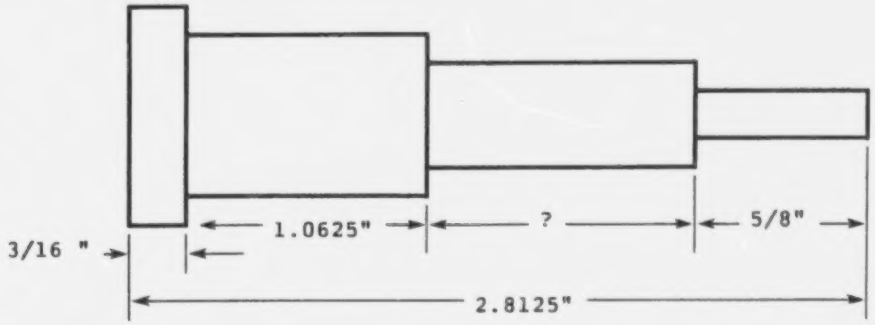


12. Find the missing metric dimension of this step-pin.



154

13. The machine shop student must find the length of the missing dimension to produce this part. Give answer as a decimal number.



14. In civil engineering, tenths of a foot is used instead of inches. How much longer is a lot 198.6 ft. than a lot 142.4 ft.?

15. Nails are assigned a number in pennies (d) such as 6^{d} or six penny. The diameter of a nail is expressed as a decimal. A 6^{d} nail is 0.113" in diameter; a 10^{d} nail is 0.148. How much greater in diameter is the 10^{d} nail?

16. The weight of one cubic foot of one solution is 10.765 pounds and the weight of one cubic foot of another solution is 15.172 pounds. How much heavier is the second solution than the first?

17. A building contractor paid $5,680.45 for labor and other expenses for a job that paid him $10,400.72. What was his profit?

18. Given the tolerances below find the shortest length possible.

	DIMENSION	TOLERANCE
a)	18.136"	± .062"
b)	8.899"	± .005"
c)	1.002"	± .012

COMPETENCY #17

Add, subtract, multiply, divide, and round decimals to a designated place value.

PERFORMANCE OBJECTIVE #27

Given two decimal numbers, find the product and round to a designated place value.

INSTRUCTIONAL ACTIVITIES

Sample Item

A truck is loaded with 52 parts. Each part weighs approximately 16.8 kilograms. What is the total weight of the load? (ans: 874 kg)

Notes

Students should be able to multiply and divide by powers of ten mentally by moving the decimal the appropriate number of places. This skill is particularly important in working with the metric system and in estimating.

Rounding answers is frequently necessary in multiplying and dividing decimals when at least one of the numbers is a measure. A total measure found by arithmetic usually has no more decimal places than the least precise of the measurements used to get the answer unless otherwise stated.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 353 and 359, skills 1 and 7.

EVALUATION

1. The thickness of a piece of sheet metal is 0.218". To the nearest hundredth of an inch, what is the thickness of 18 sheets of this metal?
2. A mechanic works at a job for 3.5 hours. The garage pays the mechanic $5.15 an hour. To the nearest cent, how much does the job cost?
3. A certain steel bar weighs 3.9 pounds per linear foot. To the nearest tenth of a pound, how much will 18.25 feet of this steel weigh?
4. Find the product of 4.16 and 8.32 to the nearest thousandth.

ANSWERS TO EVALUATION

1. 3.92"
2. $18.03
3. 71.2 pounds
4. 34.611

ANSWERS TO APPLICATIONS

1. $91.35
2. $92.30
3. $134.55
4. 3,976 pounds
5. 25.0 pounds
6. $248.44
7. .269"
8. 3329.625
9. 18.8496"
10. $.20

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #27

Performance Objective #27: Given two decimal numbers, find the product and round to a designated place value.

1. Find the cost to the nearest cent of 21 bags of mortar mix at $4.35 a bag.

2. A bricklayer purchased 85 eight-inch blocks at 65 cents each and 65 four-inch blocks at 57 cents each. What was the amount of the bricklayer's bill to the nearest hundredth?

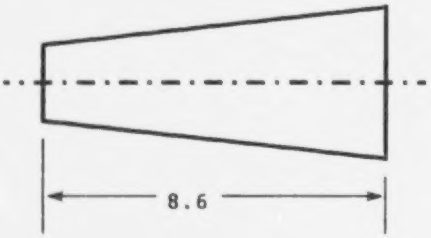
3. Find the cost to the nearest cent of 13 tons of sand at $10.35 per ton.

4. What is the weight to the nearest whole number of 1,500.5 square feet of flooring if the weight per square foot is 2.65 pounds?

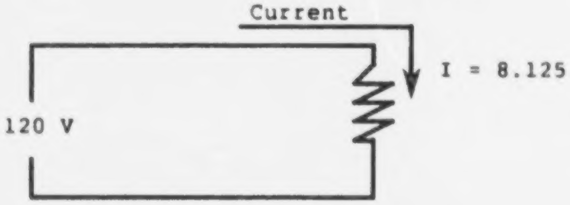
5. The weight of 1/4" plate glass is 3.28 lbs. per sq. ft. What is the weight of a piece of 1/4" plate glass at 7.62 sq. ft. rounded to the nearest tenth?

6. A carpenter works for $6.25 per hour. During one week he worked 39.75 hours. How much did he earn? (Round off to the nearest cent.)

7. The taper per inch in the gage shown in the drawing below is 0.0313". Find the total taper to the nearest thousandth in the gage.

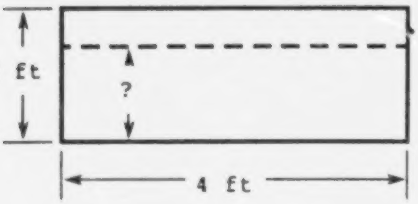


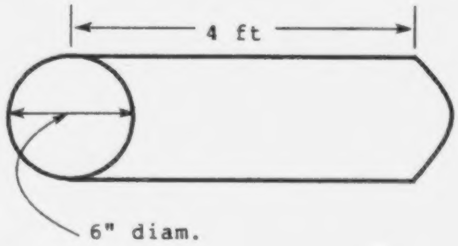
8. Electrical energy may be converted into heat energy by multiplying voltage times current times a constant of 3.415. How much heat energy will the heater in the diagram produce? (Round to the nearest thousandth.)



Heat = volts x current x 3.415

9. A round pipe is to be made from a piece of flat sheet metal. The pipe will be 4 feet long and 6 inches in diameter.





The circumference of a circle is the diameter x 3.1416. The circumference of the pipe is ______________? (Do not round the answer.)

10. How much will it cost to operate an electric heater if the heater uses 0.45 KW of power per hour and is on 8 hours. The cost is $0.055 per each KWH. (Round the answer to the nearest cent.)

COMPETENCY #17

Add, subtract, multiply and divide decimals and round to the designated place value.

PERFORMANCE OBJECTIVE #28

Given two decimal numbers, find the quotient and round to the designated place value.

INSTRUCTIONAL ACTIVITIES

Sample Item

If an automobile travels 375.4 miles in 6.25 hours, what is its average rate to the nearest mile per hour? (ans: 60 mph)

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 353 and 360, skills 1 and 8.

EVALUATION

1. A truck was hauling 6,300 pounds of steel. How many tons is this to the nearest tenth? (1 ton = 2,000 lbs.)
2. A mechanic worked 40.5 hours last week and made $212.63. What is the hourly rate to the nearest cent?
3. An airplane propeller 4.25" thick is made of six (6) layers of uniformly thick laminating material. What is the thickness of each layer of material to the nearest hundredth?
4. $146.2 \div 0.043 = ?$
5. A pipe has a circumference of 4.2 cm. What is the diameter of the pipe to the nearest tenth of a cm?
   $\Pi = 3.14 \quad d = c/\Pi$
6. A car can travel a maximum of 425 miles on a tank of gas. If the tank holds 14.3 gal., how many miles per gallon can the car average to the nearest tenth?

ANSWERS TO EVALUATION

1. 3.2 ton
2. $5.25 per hour
3. 0.71"
4. 3,400
5. 1.3 cm
6. 29.7 mpg

ANSWERS TO APPLICATIONS

1. 38 hours
2. 4,000 bolts
3. 125 pieces of tile
4. $1.61
5. 2515.3 cubic inches
6. 1.8 amps
7. 56¢ or $.56
8. 7 refrigerators
9. $135.50 per thousand
10. 180.82 watts
11. $10.35

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #28

Performance Objective #28: Given two decimal numbers, find the quotient and round to a designated place value where indicated.

1. A cabinetmaker earns $9.65 per hour. His/her paycheck was $366.70. How many hours did he/she work?

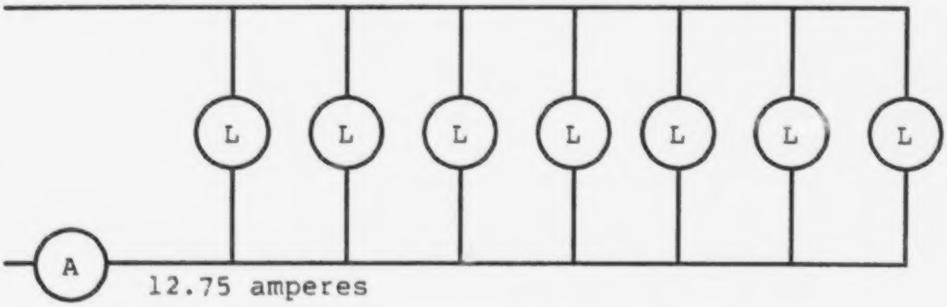
2. The net weight of the bolts in a keg is 250 pounds. Each bolt weighs 0.025 pounds. How many bolts are there in the keg.)

3. How many pieces of tile each 0.1321" thick are these in a stack 16.50" high? (round to nearest unit)

4. If R-12 refrigerant costs $48.16 for 30.0 pounds, what is the cost per pound rounded to the nearest cent?

5. One cubic inch of brass weighs 0.295 pounds. A brass casting weighs 742 pounds. Find the number of cubic inches in the casting. Round to the nearest tenth.

6. If the lamps require a total of 12.75 amperes, how many amperes will one lamp require rounded to the nearest tenth? All the lamps are of the same type and each requires the same number of amperes.



7. A contractor gives an estimate of $695.75 for laying 1,250 square feet of concrete sidewalk. What is the estimated price for each square foot of sidewalk. Round to the nearest cent.

8. Refrigerators are being charged with refrigerant using a Dial-A-Charge cylinder. The cylinder contains 8.375 pounds at the start of the charging. Each refrigerator will have 1.125 pounds of refrigerant added. How many refrigerators can be charged? Round to the nearest unit.

9. A contractor figured the cost for the labor of laying 12,000 common bricks at 1,626. What was the price per 1000 bricks?

10. The power for a circuit is 1265.75 watts. Seven equal units use this amount of power. Find the number of watts used per unit, rounded to the nearest hundredth.

1. If 11 tons of sand costs $113.85, what is the cost per ton of sand? Round to the nearest dollar.

COMPETENCY #17

Add, subtract, multiply and divide decimal numbers and round to designated place value.

PERFORMANCE OBJECTIVE #29

Given any combination of decimal numbers, perform any of the four basic math operations.

INSTRUCTIONAL ACTIVITIES

Sample Item

A part-time technician earns $3.57 per hour. What is his salary if he worked 27 hours? $3.57 x 27 = $96.39

Notes

Students, up until this point, have been required to work groups of problems illustrating one operation. This exercise incorporated a mixture of operations and the student must decide which operation (s) to use.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 358-360, skills 6-8.

EVALUATION

1. If resistors cost $.06 each, what is the cost of 250 resistors?

2. If 130 light bulbs cost $59.22, what is the price of one light bulb rounded to the nearest cent?

3. Three steel beams are loaded onto a truck. Find the total weight of the beams loaded if their individual weights are 322.96 lbs., 588.06 lbs. and 637.34 lbs..

4. The atomic weight of platinum is 195.1 and the atomic weight of tin is 118.7. What is the difference in the atomic weights of the two elements?

ANSWERS TO EVALUATION

1. $15.00
2. $.46
3. 1548.36 lbs.
4. 76.4 atw difference

ANSWERS TO APPLICATIONS

1. 29.115"
2. 31.46"
3. 7.999" or 8.0"
4. 0.026"
5. 0.251 lb/ft
6. 69.94 cm
7. 18.419"
8. $4,647.88
9. 9.024 lbs.
10. 1.351"

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #29

Performance Objective #29: Given any combination of decimal numbers, perform any of the four basic mathematical operations.

1. What length of drill rod is needed to make 24 pins each 1.124 inches long when 0.093" is allowed for each pin?

2. What is the total width of three strips of galvanized iron 8.75", 6.53" and 16.18" wide?

3. From a piece of drill rod 25.75" long, three pieces are to be cut. The first piece is to be 4.688" long, the second is to be 2.75", and the third is to be 9.938". If a total of 0.375: is wasted in cutting the drill rod, what is the leftover length?

4. A capillary tube has an inside diameter of 0.031: and an outside diameter of 0.083". Find the wall thickness of the tube.

5. A coil of copper refrigerator tubing weighs 6.275 pounds. The coil is 25 feet long. What is the weight of one foot of tubing?

6. Five wires are connected together. Find the total length if the wires are 11.3 cm, 19.7 cm, 14.75 cm, 6.15 cm, and 18.04 cm long.

7. A welder cuts 6 pieces of steel angle, each 3.0698 inches long. The total length is rounded to the nearest thousandth inch. What is the total length? Disregard waste caused by the width of the cuts.

8. A garage owner buys 35,480 gallons of gasoline at $1.258 per gallon. If the gasoline is sold for $1.389 per gallon, what is the profit?

9. The slab for a fireplace hearth requires 8 pieces of 3/8" reinforcing rod each 3 feet long. If the rod weighs 0.376 pounds per foot, how much do the eight pieces weigh?

10. The outside diameter of a section of pipe is 2.125". The wall thickness is 0.387". Find, in inches, the inside diameter of the pipe.

COMPETENCY #18

Make conversions within the metric system.

PERFORMANCE OBJECTIVE #30

Given an linear measure in metric units, write an equivalent using a different unit.

INSTRUCTIONAL ACTIVITIES

Sample Item

14 cm = ________ mm (ans: 140)

Notes

Conversions are made among these units: kilometer, meter, centimeter and millimeter. Refer to notes for Performance Objective #19. Allow students to use a meter stick as a reference when making conversions.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 111 and table on page 387.

EVALUATION

1. 63 mm = ________ cm
2. 45 cm = ________ mm
3. 38 mm = ________ m
4. 96 cm = ________ m
5. 4 m = ________ cm

ANSWERS TO EVALUATION

1. 6.3
2. 450
3. 0.038
4. 0.96
5. 400

ANSWERS TO APPLICATIONS

1. 0.00253 m
2. .0439 m
3. 61.7 cm
4. 9890 cm
5. 0.012 km
6. 730 cm
7. 1.75 m
8. 7.6 cm
9. 365 mm
10. 3,800 m
11. 11.8 cm x 20.5 cm
12. 126.4 m
13. 3,500 m

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #30

Performance Objective #30: Given a linear measure in metric units, write an equivalent measure using a different unit.

Conversions

1. 0.253 cm = _________ m
2. 43.9 mm = _________ m
3. .617 m = _________ cm
4. 98.9 m = ________ cm
5. 12 m = _________ km
6. 7.3 m = _________ cm
7. 175 cm = _________m
8. 76 mm = _________ cm
9. 36.5 cm = ________ mm
10. 3.8 km = _________ m

Given: 10 millimeters (mm) = 1 centimeter (cm)

10 cm = 1 decimeter (dm)

10 dm = 1 meter (m)

1000 m = 1 kilometer (km)

11. A switch box measures 118 mm by 205 mm. What are the dimensions in centimeters?
12. An electrical cable is to be placed between two buildings which are 120 meters apart. The cable will be pulled inside each building 32 decimeters. What will be the total cable needed in meters?
13. Pipe was laid in a ditch which was 3.5 kilometers long. How many meters would this be?

COMPETENCY #19

Find the perimeter of a polygon using metric units.

PERFORMANCE OBJECTIVE #31

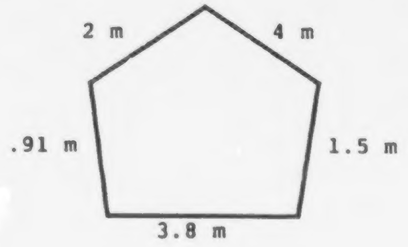
Given a polygon with dimensions in metric units, find the perimeter.

INSTRUCTIONAL ACTIVITIES

Sample Item

Find the perimeter.

(ans: 12.21 m)



Notes

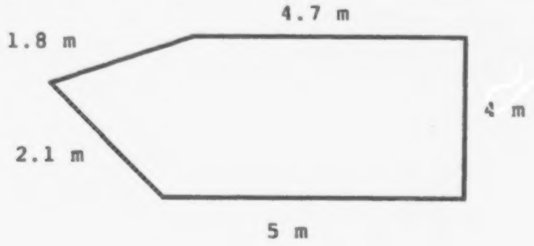
Have students measure actual pieces of metal, the room or marked off areas in the school yard to get the necessary dimensions to compute the perimeter.

REFERENCE TO TEXT

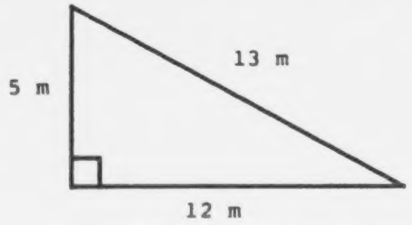
CAREER MATHEMATICS, pages 73-75, 99-100.

EVALUATION

1. Find the perimeter of a rectangle with dimensions 8 meters by 12 meters.
2. How many meters of landscaping timbers are needed to border this flower garden?



3. Find the perimeter.



4. How many meters of baseboard are needed for a room that is 3.8 m by 4.3 m?

ANSWERS TO EVALUATION

1. 40 m
2. 17.6 m
3. 30 m
4. 16.2 m

ANSWERS TO APPLICATIONS

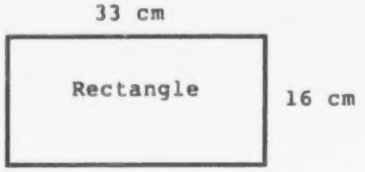
1. 98 cm
2. 336 mm
3. 34 m
4. 147 m
5. 21.76 m
6. 65.8 m
7. 12.6 m
8. a) 12 cm
   b) 13.6 cm
   c) 17.7 cm

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #31

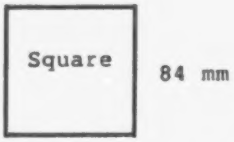
Performance Objective #31: Given a polygon with dimensions in metric units, find the perimeter.

The perimeter of a polygon is the sum of the lengths of the sides. Find the perimeter of the following polygons.

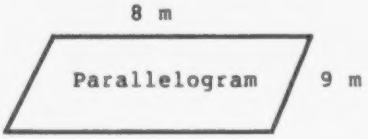
1.


33 cm
Rectangle
16 cm

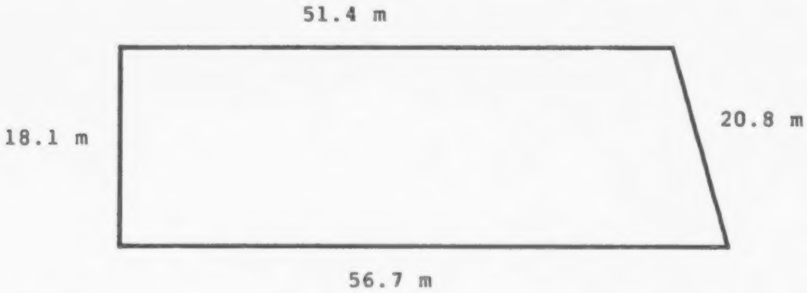
2.


Square
84 mm

3.


8 m
Parallelogram
9 m

4. How many meters of fence are needed to enclose this lot?


51.4 m
18.1 m
20.8 m
56.7 m

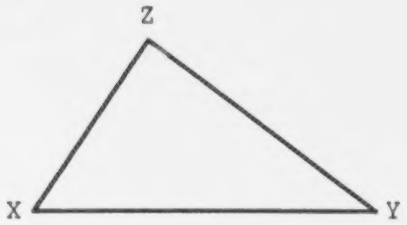
5. How many meters of ceiling molding are needed to go around a room that is 4.7 m x 6.18 m?

6. What is the perimeter of a house that is 15.8 m by 17.1 m?

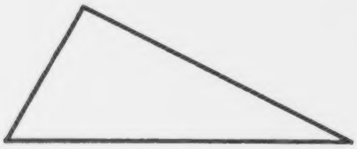
7. How many meters of carpet binding are needed for a rug that is 2.8 m by 3.5 m?

8. Measure the figures and give their perimeter in centimeters.

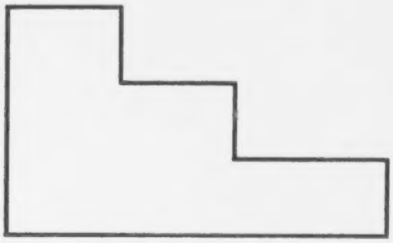
A



B



C



COMPETENCY #20

Explain and use tolerance.

PERFORMANCE OBJECTIVE #32

Given a measurement in metric or English units and the tolerance, state the acceptable measures.

INSTRUCTIONAL ACTIVITIES

Sample Item

Find the upper and lower limits for these basic measurements and stated tolerances.

1. 3 1/2" ± 1/16" (ans: 3 9/16", 3 7/16")

2. 6.81 cm + 0.01 cm (ans: 6.82 cm)
   - 0.02 cm (ans: 6.79 cm)

Notes

When fabricating items, placing equipment, filling containers, etc., a tolerance is many times specified. This tolerance is established so that the item will fit or operate properly.

Tolerance is the amount by which the final measurement may vary from the basic or exact required measurement. Tolerances are expressed as plus (+) or minus (-). By adding or subtracting the plus and minus tolerances and the required measurement, the upper limit or maximum dimension and the lower limit or minimum dimension is the tolerance.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 26-27.

EVALUATION

Find the dimension limits for each of the following required measurements and stated tolerances.

1. 16 3/8" ± 1/16"
2. 5 1/4" ± 0.015
3. 41.63 cm ± 0.2 mm
4. 83 mm ± 0.5 mm

ANSWERS TO EVALUATION

1. 16 5/16", 16 7/16"
2. 5.265", 5.235"
3. 41.65 cm, 41.61 cm
4. 83.5 mm, 82.5 mm

ANSWERS TO APPLICATIONS

1.

	Maximum	**Minimum**
a)	10 1/8"	9 7/8"
b)	8 3/8"	8 1/8"
c)	85° 5'	84° 55'
d)	110° 30'	103° 30'

2. Yes
   1.815 - 1.817 - 1.825
3. 53.97 mm; 53.90 mm
4. 0.732" - 0.740"
5. Max: 3 lbs. 2 ozs.
   Min: 2 lbs. 12 ozs.
6. Max: 2 5/16"
   Min: 2 3/16"
7. Max: 86 ft. lbs.
   Min: 78 ft. lbs.

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE 32

Performance Objective #32: Given a measurement in metric or English units and the tolerance, state the acceptable measures.

1. What are the maximum and minimum sizes for the dimensions shown below?

	Dimension	Tolerance
a)	10"	± 1/8"
b)	8 1/4"	± 1/8'
c)	85°	± 5'
d)	107°	± 3° 30'

2. A hole is to be drilled 1.82 cm ± 0.005 cm. After drilling, the machinist measures and finds that the hole is 1.817 cm. Is this acceptable? Explain.

3. Measurements for a shaft are given as 53.97 mm $^{+\,0.00\text{ mm.}}_{-\,0.07\text{ mm.}}$

   What are the maximum and minimum measures allowed?

4. A shaft diameter is given as 0.736" ± 0.004. What is the acceptable measure range?

5. An air conditioner is to be charged with refrigerant. The tolerance is plus or minus 3 oz. The quantity stated on the data plate is 2 lbs. 15 oz. What are the maximum and minimum amounts that can be put in the air conditioner?

6. Drive strips are being fabricated from sheet metal. The strips are to be cut 2 1/4 inches wide plus or minus 1/16 inch. What are the maximum and minimum sizes of strips?

7. A bolt is to be tightened to 82 ft. lbs. of torque plus or minus 4 ft. lbs. What torques are acceptable?

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #21

Read metric and English micrometers.

PERFORMANCE OBJECTIVE #33

Given a metric or English micrometer and an object to be measured, measure the stated dimension to the nearest thousandth of an inch or hundredth of a millimeter.

INSTRUCTIONAL ACTIVITIES

INTRODUCTION

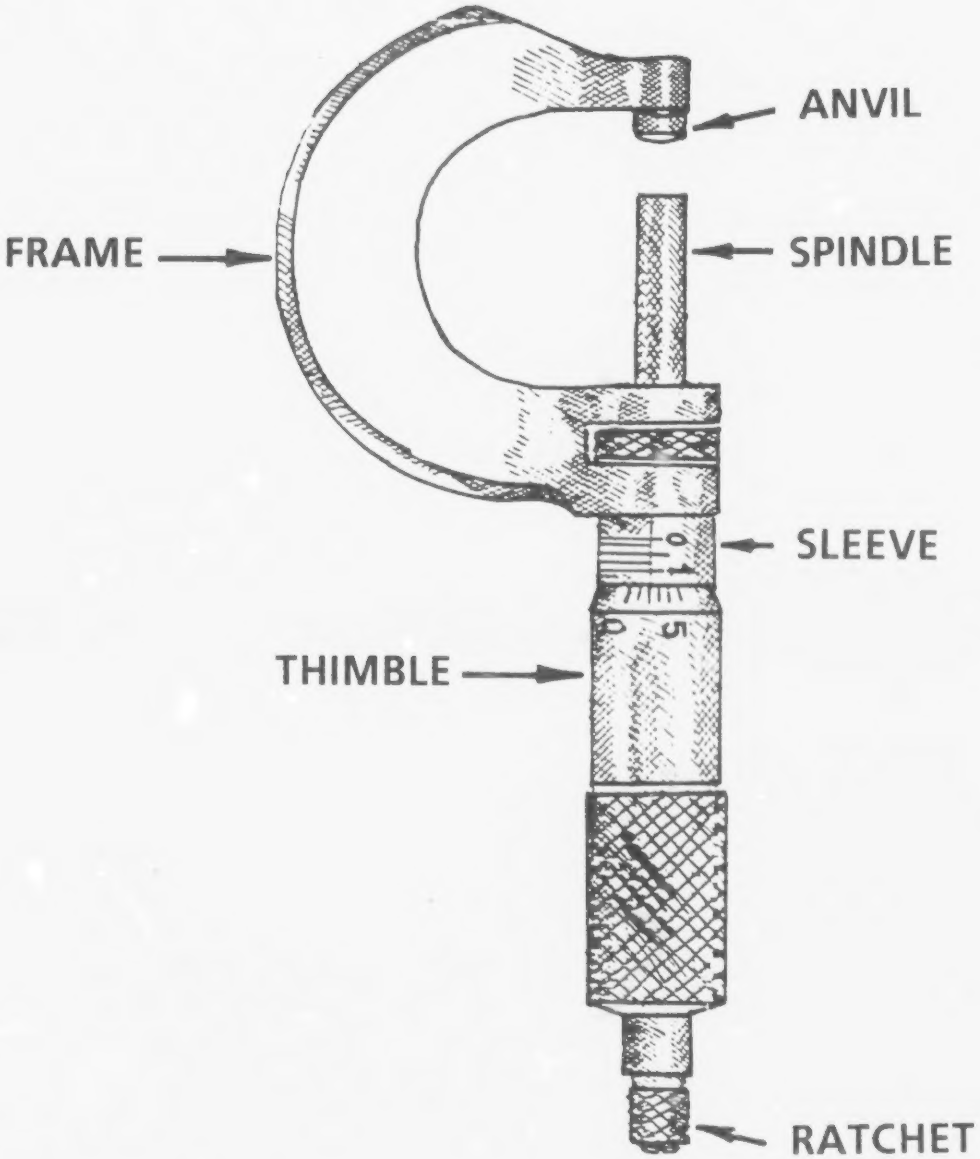
In many occupations it is essential that a person be skilled in using and reading the micrometer. The micrometer is a precision measuring instrument which is used in measuring thickness, distance and diameter. The two most commonly used micrometers are the inside micrometer and the outside micrometer. The inside micrometer is used to measure such things as the inside diameter of a cylinder. The outside micrometer is used to measure thicknesses and outside diameters of such things as crankshafts and spindles. Figure 1 shows the outside micrometer and Figure 2 shows an inside micrometer. (Figures are shown on the following pages.)

Micrometers come in many different sizes. A 0-1" micrometer will measure up to a maximum of one inch. A 1"-2" micrometer will measure distances from a minimum of 1" to a maximum of 2". Micrometer sizes continue on up by 1" intervals to most any desired reasonable size. In your work you will rarely have use for a micrometer which has a maximum limit of more than 12 inches. The most commonly found sets will measure from 0 to 6 inches.

The increments used when reading a micrometer are whole inches (1.000"), tenths of an inch (0.100"), hundredths of an inch (0.010"), and thousandths of an inch (0.001").

(Continued on next page)

MICROMETER PARTS


ANVIL
FRAME
SPINDLE
SLEEVE
THIMBLE
RATCHET

INSTRUCTIONAL ACTIVITIES (cont.)

STEPS IN READING A MICROMETER

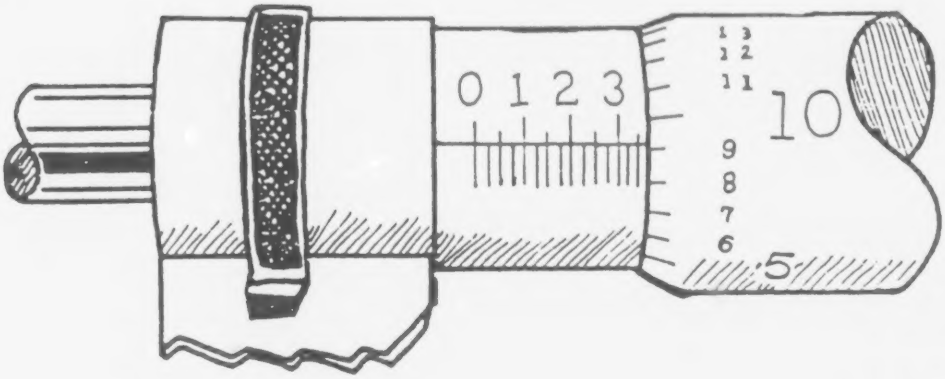
1. Determine and list the smallest number of inches that can be read using this micrometer. If this is a 0-1" micrometer the smallest number of inches is 0, 1"-2" micrometer 1" and so on.

2. Locate and list the largest number on the sleeve that the thimble edge has just passed. This indicates the reading in tenths (0.100") of an inch.

3. Count the number of full spaces that lie between the highest numbered line, line from step 2, and thimble edge. This number of full spaces is multiplied by 0.025 and this gives you the reading in hundredths (0.010") of an inch.

4. Locate the line on the thimble that lines up with the horizontal line on the sleeve. List this number in thousandths (0.001") of an inch.

5. Total up the numbers from steps 1-4 above to get the actual micrometer reading.



1" - 2" MICROMETER

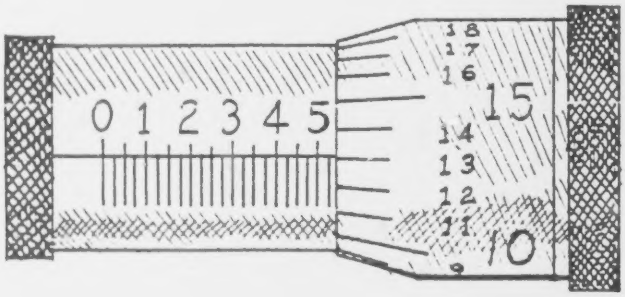
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 48-49.

EVALUATION

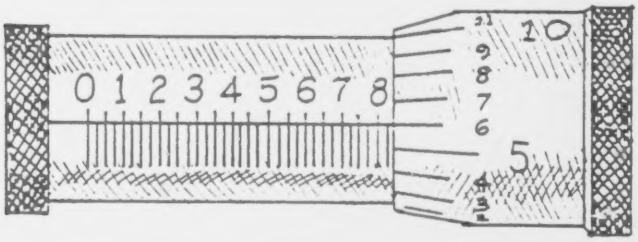
Read the following micrometers to the nearest thousandths.

I.


0 1 2 3 4 5
18
17
16
15
14
13
12
11
10
9

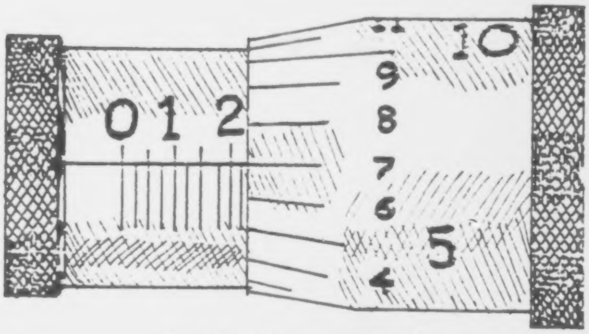
0-1" Micrometer

II.


0 1 2 3 4 5 6 7 8
11
10
9
8
7
6
5
4
3
2

1"-2" Micrometer

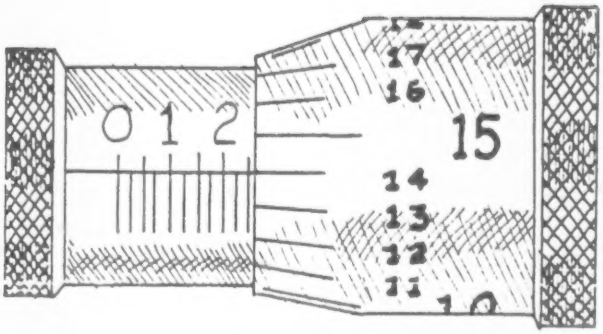
III.


0 1 2
11
10
9
8
7
6
5
4

0-1" Micrometer

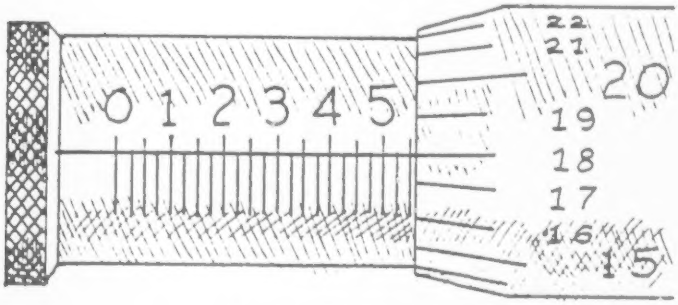
EVALUATION (CONT.)

IV.


0
1
2
17
16
15
14
13
12
11
10

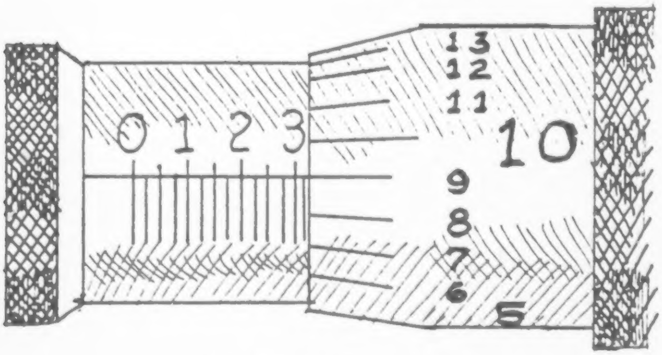
2"-3" Micrometer

V.


0
1
2
3
4
5
22
21
20
19
18
17
16
15

3"-4" Micrometer

VI.


0
1
2
3
13
12
11
10
9
8
7
6
5

1"-2" Micrometer

ANSWERS TO EVALUATION

I. .538"
II. 1.831"
III. .232"
IV. 2.264"
V. 3.568"
VI. 1.334"

ANSWERS TO APPLICATIONS

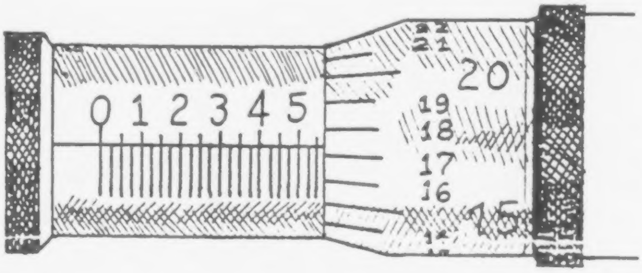
I. .567
II. .999
III. .327
IV. 2.649
V. 1.491
VI. .986

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #33

Performance Objective #33: Given a metric or English micrometer and an object to be measured, measure the stated dimension to the nearest thousandth of an inch or hundredth of a millimeter.

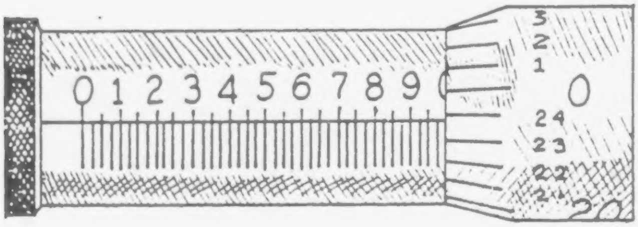
Determine the reading for each of the micrometers shown below. Make sure you take into consideration the size micrometer shown above each figure.

I.


0 1 2 3 4 5
22
21
20
19
18
17
16
15

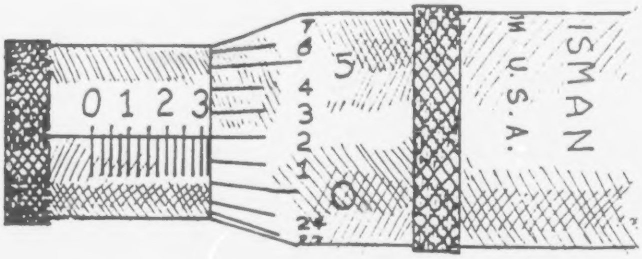
0-1" Micrometer

II.


0 1 2 3 4 5 6 7 8 9
3
2
1
0
24
23
22
21
20

0-1" Micrometer

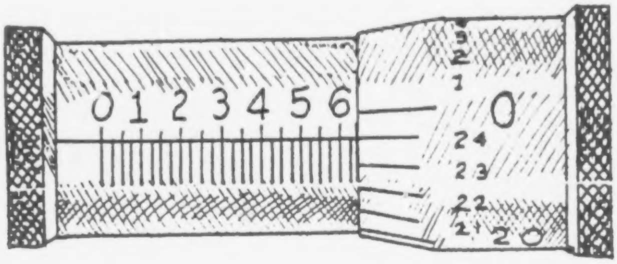
III.


0 1 2 3
7
6
5
4
3
2
1
0
24
U.S.A.
ISMAN

0-1" Micrometer

APPLICATIONS (cont.)

IV.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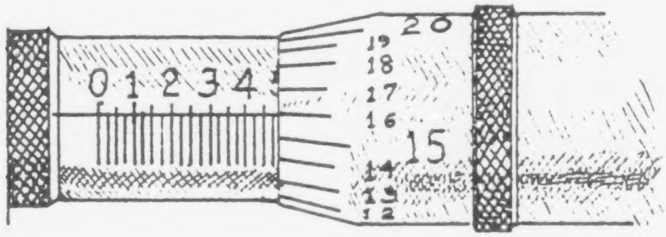
2"-3" Micrometer

V.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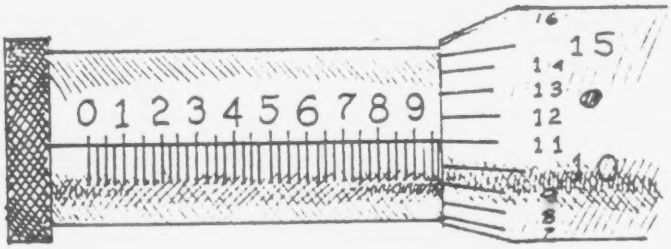
1"-2" Micrometer

VI.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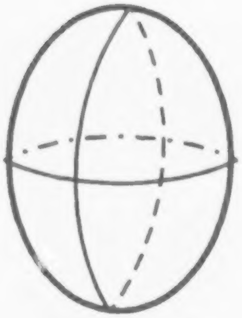
0-1" Micrometer

section III

measurement

capacity, mass, temperature



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #22

Measure capacity with English units.

PERFORMANCE OBJECTIVE #34

Given a container and a specified English unit, determine the capacity.

INSTRUCTIONAL ACTIVITIES

Sample Item

Give the student several different sizes of incremented containers and ask the student to pour 80 ounces into a bucket.

Notes

When working with ounces, cups, pints, quarts and gallons, the students learn best by doing actual measuring activities. Have the students estimate before they begin the actual measuring. Collect containers of different sizes and shapes, preferably containers commonly found in vocational settings.

Sometimes capacity must be calculated using a formula. In the cooling and heating trade, it is necessary to compute capacities of rooms, attics, basements and buildings. Normally, the formulas are given.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 202-205, 387-388.

EVALUATION

Have the student determine the capacity unit of four different containers to the nearest half-unit.

ANSWERS TO APPLICATIONS

1. a) 1,440 cu. ft.
   b) 5,760 cu. ft./hr.

2. a) 6,912 cu. in.
   b) 29.9 gal.

3. a) 9.42 cu. ft.
   b) 70.65 gal.

4. 0.67 cubic yards

5. 0.86 cubic yards

6. 3 feet

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #34

Performance Objective #34: Given a container and a specified English unit, determine the capacity to the indicated unit.

1. A room is 15 feet wide, 12 feet long and has a ceiling of 8 feet. It is necessary to change the air 4 times each hour.

   a) What is the volume of the room in cubic feet?
   b) How many cubic feet will be moved each hour?

   Given: Volume = l x w x h

2. A condensate drain pan on an air conditioner is 48 inches long, 24 inches wide and 6 inches deep.

   a) How many cubic inches of water will the pan hold?
   b) How many gallons of water will the pan hold if 1 ga. equals 231 cubic inches? (Round to nearest tenth.)

   Given: V = l x w x h

   $$\text{gal.} = \frac{\text{cu. in.}}{231 \text{ cu. in./gal.}}$$

3. A fuel oil storage tank for an oil furnace measures 3 feet high and 24 inches in diameter. What is the capacity of the tank in
   a) cubic feet and b) gallons?

   Given: V = area x height

   $= \Pi r^2 \times h$

   1 cu. ft. = 7.5 gal.

   $r = \frac{d}{2}$

4. If a cement finisher is pouring a sidewalk which is 4 inches deep, 3 feet wide and 18 feet long, how much cement will he/she use (give answer in cubic yards)? (Round to nearest hundredth.)

5. If a cement finisher is pouring a sidewalk which is 4 inches deep, 3 feet 6 inches wide and 20 feet long, how much cement will he/she use (give answer in cubic yards)? (Round to nearest hundredth.)

6. The sheet metal worker was asked to make a container to hold 27 cubic feet. If the container must fit in a floorspace only 3 feet square, how high should he/she make the container?

COMPETENCY #23

Measure capacity with metric units.

PERFORMANCE OBJECTIVE #35

Given a container and specified metric unit, determine the capacity.

INSTRUCTIONAL ACTIVITIES

Sample Item

Give the student several different sizes of metrically marked containers and ask the student to pour 1.6 liters into a bucket.

Notes

As with customary units, the students learn the units as they estimate and measure. Provide many opportunities for actual measuring.

Note that cubic measures are written with exponents in the metric system. (ex: cm^3)

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 202-205, 387-388.

EVALUATION

Have the student determine the capacity of four different containers to the nearest half-unit.

ANSWERS TO APPLICATIONS

1. a) 233,856 cm^3

   b) 0.233856 m^3

2. a) 110,715 cm^3

   b) 110.715 liters

3. a) 779,976 cm^3

   b) 779.976 liters

4. 1.5 m^3

5. 23.76 m^3

6. 3.33 cm

7. 5,203.733 cu. ft. = 39,028 gallons

8. 467 gals.

9. 124.666 or 124 1/2 cubic yards

10. 1.47 or 1.5 cubic yards

APPLICATIONS FOR PERFORMANCE OBJECTIVE #35

Performance Objective #35: Given a container and specified metric unit, determine the capacity.

1. A refrigerator measures 48 cm wide, 116 cm high, and 42 cm deep. a) What is the capacity in cubic centimeters? b) cubic meters?

   Given: $V = l \times w \times h$ $1\ m^3 = 1{,}000{,}000\ cm^3$

2. A condensate drain pan on an air conditioner is 121 cm long, 61 cm wide and 15 cm deep. a) How many cm^3 of water will the pan hold? b) How many liters (L) will this pan hold if 1 liter equals 1,000 cm^3?

3. A fuel oil storage tank measures 276 cm high and 60 cm in diameter: What is the capacity of the tank in a) cm^3? b) liters?

   Given: $1{,}000\ cm^3 = 1$ liter $V = \pi r^2 \times h$

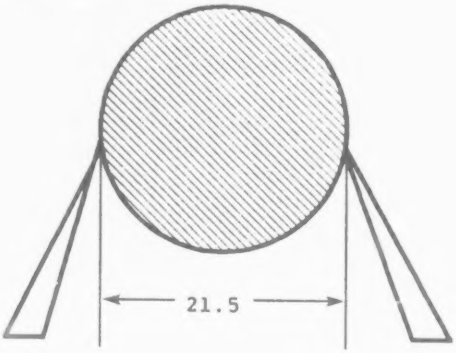
4. If a cement finisher is pouring a sidewalk which is .1 meter deep, 1 meter wide and 15 meters long, how much cement will he/she use?

5. If a mason is pouring a cement footing which is .3 meters deep, .5 meters wide and 158.4 meters long, how much cement will he/she use?

6. The glassblower was asked to make a special bottle to hold 270 cubic centimeters. If the container must fit in a space only 9 centimeters square, how high should he/she make the container? (Round to the nearest hundredth.)

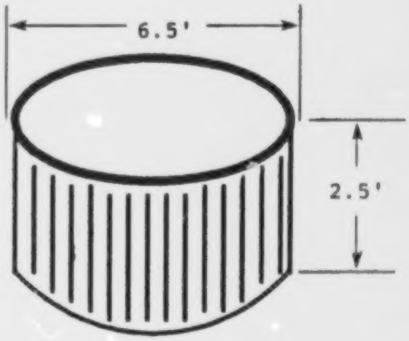
7. What is the capacity in gallons of a spherical tank whose diameter is 21.5 ft? A cubic foot contains about 7 1/2 gallons. (Answer to the nearest gal.)

   ($V = .523d^3$)



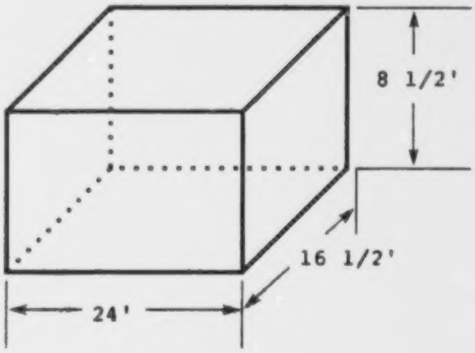
8. The James family wishes to construct a round wooden tub with a flat bottom. The size of the tub will be 6.5 ft. in diameter and 2.5 feet high. How many gallons of water will it take to fill the tub to 3/4 of its capacity? (Answer to the nearest gallon.)

(Formula: $V = .7854d^2h$)
(Approx. 7 1/2 gallons per cubic foot)



9. Find the number of cubic yards of air in a room 24 feet long, 16 1/2 feet wide and 8 1/2 feet high. (Answer to the nearest 1/2 cubic yard.)

(27 cu. ft. = 1 cu. yd.)
($V = lwh$)



10. Determine the number of cubic yards of concrete in a column 10 feet high and 27 inches in diameter. (Change 27" to 2.25 ft.)

($V = .7854d^2h$) (Round to nearest 1/2 cubic yard.)

COMPETENCY #24

Measure mass with English units.

PERFORMANCE OBJECTIVE #36

Given an item and a specified English unit, determine its mass to the nearest half-unit.

INSTRUCTIONAL ACTIVITIES

Sample Item

Determine the weight to the nearest half-ounce of a piece of metal.

Notes

General: Try to provide students with opportunities to use the different types of scales they will encounter in the vocational fields. Again, it is important that students estimate and measure the weights of various objects, preferably items such as they will encounter in their work: bricks, mortar, lumber, metal, etc.

Heating/Air Conditioning: Weights of substances (solids, liquids, gases) are important in the heating and cooling trade. The serviceperson needs to know the weight of air to be moved by a fan, the weight of water in a cooling tower that must be supported by a roof, or the weight of metal to be transported.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 202-205, 387-388.

EVALUATION

Give the student four different items to be weighed and the designated units to use.

ANSWERS TO APPLICATIONS

1. 7,747.2 or 7,747 lbs/hr.
2. total weight 2,488 lbs; therefore, 488 lbs overloaded
3. tower: 1,025 lbs.
   water: 3,994 lbs.
   total: 5,019 lbs.
4. 18 cans
5. 16,800 gallons

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #36

Performance Objective #36: Given an item and a specified English unit, determine its mass.

1. An air conditioning centrifugal fan is to move 1,600 CFM (cubic feet per minute) of air. How many pounds of air will be moved per hour if the weight density of air at 32°F is 0.0807 lbs/ft^3?

2. A truck that has a load limit of 1 ton has been loaded with the following items: Condensing unit -- 600 lbs, air handler -- 250 lbs and a compressor -- 150 lbs. Would the truck be overloaded if 62 pieces of 4 ft. x 8 ft., 26 gage sheet metal were also loaded on the truck? If yes, how much is the truck overloaded? Weight per square foot of 26-gage sheet metal is 0.75 lbs.

3. A redwood cooling tower that weighs 1,025 lbs. is to be placed on the roof of a building. The reservoir on the tower is 8 ft. long, 4 ft. wide and 2 ft. deep and will be filled with water. If the weight density of water is 62.4 lbs/ft^3, what will be the total weight of the tower and water? Given: Vol = l x w x h. (Round to the nearest pound.)

4. The dietetic technician needs 132 servings of juice. If juice is supplied in 46 ounce cans and each serving is 6 ounces, how many cans of juice will be needed?

5. A water tank has a volume pf 5,600 cubic feet and the tank is 4/10 full. How many gallons of water are in the tank? (1 cubic foot = 7.5 gallons)

COMPETENCY #25

Measure mass with metric units.

PERFORMANCE OBJECTIVE #37

Given an item and a specified metric unit, determine its mass to the nearest half-unit.

INSTRUCTIONAL ACTIVITIES

Sample Item

Give the student a piece of metal to weigh to the nearest gram.

Notes

Metric weights are usually given in grams or kilograms.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 202-205, 387-388.

EVALUATION

Give the student four items to be weighed and the designated unit(s) for recording the masses.

ANSWERS TO APPLICATIONS

1. 2,715.3 or 2,715 kg/hr

2. V = 1,328,848 cm^3
   Mass = 1,089,655 grams = 1,090 kilograms

3. V = 87,920 cm^3
   Mass when half full = 57,148g or about 57 kg

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #37

Performance Objective #37: Given an item and a specified metric unit, determine its mass.

1. A furnace fan is designed to move 35 CMM (cubic meter per minute) of air. If air at 0°C has a mass density of 1.293 kg/m^3, how many kilograms of air will be moved each hour?

2. An oil tank 92 cm in diameter and 200 cm in height is to be filled with fuel oil. The oil has a mass density of 0.82 $gram/cm^3$. When the tank is full of oil, how much will the oil weigh? (Round to nearest whole number.)

   Given $V = \Pi r^2 \times h$

3. A R-12 refrigerant drum is 40 cm in diameter and 70 cm in height. Liquid R-12 at 24°C has a mass density of 1.3 $grams/cm^3$. How much does the refrigerant weigh when the drum is half full?

COMPETENCY #26

Make conversions within systems among capacity units and among mass units.

PERFORMANCE OBJECTIVE #38

Given an English capacity or mass measurement, write an equivalent English measurement using a different unit.

INSTRUCTIONAL ACTIVITIES

Sample Item

1 cubic foot = ________ cubic inches (ans: 144)

1 1/2 qts. = _________ ounces (ans: 48)

40,000 pounds = __________ tons (ans: 20)

Notes

The service person takes technical information from blueprints, schematic drawings, installation instructions, etc. It is very often necessary to change from one unit of measure to another unit of measure. Conversion tables are available in many technical publications and textbooks.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 387.

EVALUATION

Complete:

1. 82 ounces = _________ quarts
2. 37 quarts = _________ gallons
3. 5 cubic yards = _________ cubic feet
4. 3 1/2 tons = _________ pounds

ANSWERS TO EVALUATION

1. 2.5625 qts.
2. 9 1/4 gals. or 9.25 gals.
3. 135 cubic feet
4. 7,000 pounds

ANSWERS TO APPLICATIONS

1. 5 gallons
2. 22,000 lbs.
3. 9.5 tons
4. a) 18.5 cubic feet

   b) 0.685 cubic yards or 0.69 cubic yards
5. 5,184 cubic inches
6. 87.6 pounds
7. 1 gallon 3 quarts or 7 quarts

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #38

Performance Objective #38: Given an English capacity or mass measurement, write an equivalent English measurement using a different unit.

1. A bucket holds 20 quarts of water. How many gallons does it hold?

2. A dump truck arrives with 11 tons of sand. How many pounds of sand is it carrying?

3. If a 12" block weighs 38 lbs., how many tons would 500 blocks weigh?

4. A concrete pad for a hundred-ton air conditioner is to be poured. The pad measures 12 feet 4 inches by 4 feet 6 inches by 4 inches. a) How many cubic feet of concrete will be needed?
   b) How many cubic yards of concrete will be needed?

5. A tank is being constructed to hold 22.5 gallons of liquid coil cleaner. What size tank in cubic inches should be constructed? (1 cubic foot = 7.5 gallons)

6. Six drums of refrigerant R-22 have been weighed as follows: 28 lbs. 2 oz.; 4 lbs. 14 oz.; 14 lbs. 5 oz.; 8 lbs. 9 oz.; 12 lbs. 1 oz. and 19 lbs. 11 oz. What is the total amount of refrigerant on hand in pounds to the nearest tenth?

7. How should you express 28 cups in order to prevent the cook from making counting mistakes?

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #26

Make conversions within systems among capacity units and among mass units.

PERFORMANCE OBJECTIVE #39

Given a metric capacity or mass measurement, write an equivalent metric measurement using a different unit.

INSTRUCTIONAL ACTIVITIES

Sample Item

2.5 liters = __________ milliliters (ans: 2,500)

456 grams = __________ kilograms (ans: 0.456)

3,330 cm^3 = __________ L (ans: 3.330)

Notes

The service person takes technical information from blueprints, schematic drawings, installation instructions, etc. It is very often necessary to change from one unit of measure to another unit of measure. Conversion tables are available in many technical publications and textbooks.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 387.

EVALUATION

Complete:

1. 4.2 L = ____________ cm^3
2. 1,763 mL = __________ L
3. 5,276 g = __________ kg
4. 5.1 L = ___________ mL

ANSWERS TO EVALUATION

1. 4,200 cm^3
2. 1.763 L
3. 5.276 kg
4. 5,100 m

ANSWERS TO APPLICATIONS

1. 25,000 L
2. 0.333 L
3. 4.325 kg
4. 21,800 mg
5. 677.6 hg
6. 7.568 L
7. 8.324 L
8. 2,500 cm^3
9. 6 hrs. 40 mins. or 6.67 hrs.
10. 16 servings

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #39

Performance Objective #39: Given a metric capacity or mass measurement, write an equivalent metric measurement using a different unit.

1. 25 kL = __________ L

2. 333 mL = ____________ L

3. 4,325 g = ___________ kg

4. 21.8 g = ____________ mg

5. A condensing unit weighs 111.36 kilograms. When the compressor is removed from the condensing unit, the weight is 43.6 kilograms. How much does the compressor weigh in hectograms?

6. A 2-ton compressor requires 473 milliliters (mL) of refrigerant oil. Sixteen compressors are to be filled. How much oil will be required in liters?

7. A dial-a-charge refrigerant cylinder contains 8,324 cubic centimeters (cm^3). Convert this capacity to liters.

8. How many cubic centimeters are contained in a 2.5 liter engine?

9. If an empty fuel tanker has a volume of 20,000 liters, and oil is pumped into the tanker at a rate of 50 liters per minute, how long would it take to fill the tank?

10. How many 250 mL servings of punch can be served from 4 L?

COMPETENCY #27

Read Fahrenheit and Celsius thermometers.

PERFORMANCE OBJECTIVE #40

Given a Fahrenheit or Celsius thermometer, read the temperature to the nearest half-degree.

INSTRUCTIONAL ACTIVITIES

Notes

Have students measure the temperature in both Fahrenheit and Celsius of items and places such as:

1. water from hot and cold faucets.
2. water from cold water fountain.
3. room temperature in various spots.
4. dirt temperature at ground level and 6 inches down.

These temperatures on the Celsius scale should be memorized.

1. 0° -- water freezes

2. 20-22° -- comfortable room temperature

3. 37° -- normal body temperature

4. 100° -- water boils

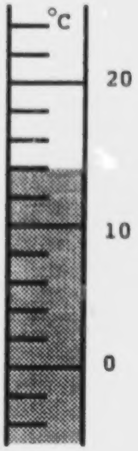
REFERENCE TO TEXT

None

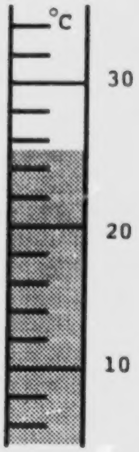
EVALUATION

1. Read these Celsius thermometers to the nearest half-degree.

A.

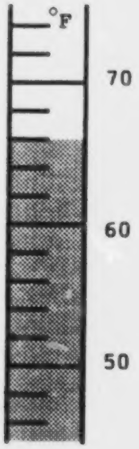


B.

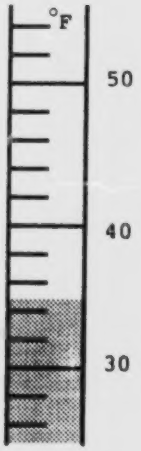


2. Read these Fahrenheit thermometers to the nearest half-degree.

A.



B.



ANSWERS TO EVALUATION

1. a) 14°C
   b) 25°C
2. a) 66°F
   b) 35°F

ANSWERS TO APPLICATIONS

1. c
2. d
3. e
4. b
5. a
6. a) 24°C
   b) 8°C
   c) 38°C
7. a) 44°F
   b) 85°F
   c) 21°F

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #40

Performance Objective #40: Given a Fahrenheit or Celsius thermometer, read the temperature.

1. A reading of 0°o is closest to which Fahrenheit reading?

   a) 0° F　　d) 100°F

   b) 10°F　　e) 212°F

   c) 32°F

2. Normal body temperature is:

   a) 0°C　　d) 37°C

   b) 20°C　　e) 98°C

   c) 22°C

3. Water boils at:

   a) 0°F　　d) 100°F

   b) 32°F　　e) 212°F

   c) 37°F

4. Which temperature is lower?

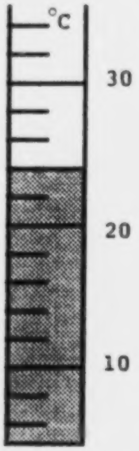
   a) 0°C　　b) 0°F

5. Which temperature is higher?

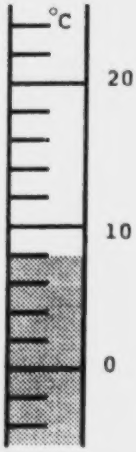
   a) 32°C　　b) 32°F

6. Give the reading on these metric thermometers to the nearest half-degree.

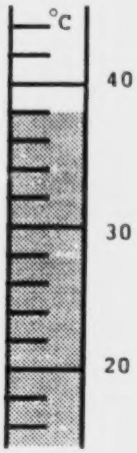
a.



b.

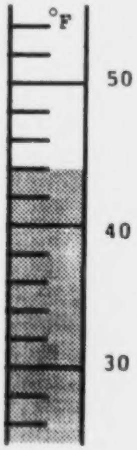


c.

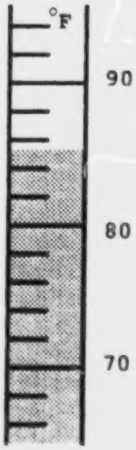


7. Give the readings on these customary thermometers to the nearest whole degree.

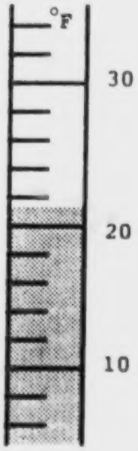
a.



b.

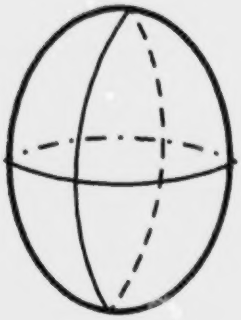


c.



section IV

introduction to basic algebra



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #28

Explain meaning of signed numbers.

PERFORMANCE OBJECTIVE #41

Given a list of positive and negative numbers and a list of interpretations, match the number to the meaning.

INSTRUCTIONAL ACTIVITIES

Sample Item

Match:

1. -1 a) a gain of one yard
2. +1 b) a loss of one yard

(ans: 1. b, 2. a)

Notes

Although operations with signed numbers are not used very often in the trades and industries, the meaning of signed numbers is quite important.

REFERENCE TO TEXT

None

EVALUATION

Match:

1. -2 a) a gain of two
2. +2 b) a loss of three
3. -3 c) down 2
4. +3 d) up three

ANSWERS TO EVALUATION

1. c
2. a
3. b
4. d

ANSWERS TO APPLICATIONS

1. +12 mph
2. -$0.40
3. -$24,500
4. -13.5v
5. +0.8%
6. +15 km
7. +18 lbs. psi
8. -15 yds.
9. +250 ft.
10. -3/8

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #41

Performance Objective #41: Given a list of interpretations, state the signed numbers.

Express these as a signed number.

1. A speed increase of 12 mph
2. A salary decrease of $0.40 per hour
3. A company's liabilities of $24,500
4. A circuit voltage loss of 13.5 volts
5. A 0.8% expansion in the length of wire
6. 15 kilometers north
7. A pressure increase of 18 pounds per square inch
8. A loss of 15 yards
9. 250 feet above sea level
10. The price of the stock fell 3/8

214

COMPETENCY #29

Apply the proper order of operations to solve a formula.

PERFORMANCE OBJECTIVE #42

Given a formula for a variable and all other values, solve for the variable by applying the proper order of operations.

INSTRUCTIONAL ACTIVITIES

Sample Item

Find P when $l=100$ and $w=20$: $P = 2l + 2w$
(ans: 240)

Notes

General: Learning to solve formulas in the proper order is one of the most important skills needed in a vocational math course. The potential of encountering formulas in any type of vocation is very real.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 73-97.

EVALUATION

1. Find H when $P=1.125$: $H = P/2 + 0.01$
2. Find F when $C=100$: $F = 1.8C + 32$
3. Find V when $l=10$, $w=20$, $h=3$: $V = lwh$
4. Find E when $I=20$ and $R=20$: $E = IR$
5. Find C when $\Pi = 22/7$ and $r=7$: $C = 2\Pi r$

ANSWERS TO EVALUATION

1. .5725
2. 212
3. 600
4. 400
5. 44

ANSWERS TO APPLICATIONS

1. 2 amperes
2. 80 lb/sq. ft.
3. 26 2/3°C or 26.67°C
4. 2826 cu. in.
5. 6.6725 in.
6. 400 yds.
7. 153.86 sq. m.

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #42

Performance Objective #42: Given a formula for a variable and all other values, solve for the variable by applying the proper order of operations.

1. What is the current in a 3 ohm circuit connected to a 6-volt battery?

   $I = E/R$

   E is electromotive force in volts
   R is resistance in ohms
   I is current in amperes (volt/ohm)

2. The hydraulic lift is an application of Pascal's Law $P=F/A$. How much pressure (lbs/sq. ft.) is necessary to lift 800 lbs. on a lift that is 10 sq. ft. in surface area?

   F is force in lbs.
   A is surface area in sq. ft.

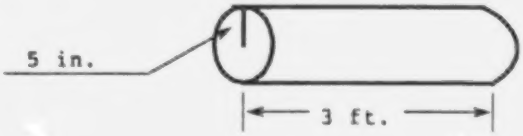
3. If the temperature is 80°F, what is the temperature in C?

   $C = 5/9(F-32)$

4. Find the volume of the cylindrical pipe. Express your answer in cubic inches.

   $V = \Pi r^2 h$

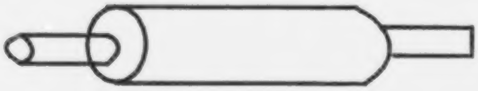
   $\Pi = 3.14$



5. Find the circumference of the offset press feed roll shown below. ($C= \Pi d$)

   Diameter = 2.125"

   $\Pi = 3.14$



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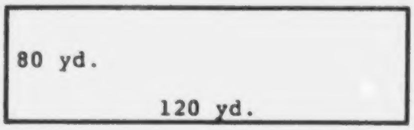
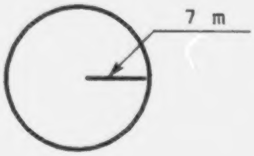
6. How much wire should you buy to string lights around all 4 sides of this football field?

$P = 2l + 2w$



7. Find the area of a circle whose radius is 7 meters. (use $\Pi = 3.14$)

$(A = \Pi r^2)$



COMPETENCY #30

Apply the rules for solving for any variable in a formula.

PERFORMANCE OBJECTIVE #43

Given a formula, solve for any variable in terms of the other variables in the formula.

INSTRUCTIONAL ACTIVITIES

Sample Item

Solve for m in the formula for kinetic energy:

$k = \frac{mv^2}{2}$ (ans: $m = \frac{2k}{v^2}$)

Notes

General: The students need to learn the general rules for solving for any variable in terms of the other variables in the formula. When solving numerical problems which involve the solution of a formula, it is best to always solve the formula algebraically for the desired variable before substituting in the numerical values. This procedure permits you to check your work more easily, and the variables retain their identity through the various algebraic procedures. Once numbers are added, multiplied, etc., their identity is lost and your audit becomes more difficult.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 73-97.

EVALUATION

1. Solve for t in the distance formula $d=rt$.
2. Solve for lower case z in the formula $A = \frac{x + y + z}{3}$
3. Solve for D when $h = \frac{D - d}{2}$
4. Solve for S when $\frac{s}{S} = \frac{D}{d}$
5. Solve for A when $P = \frac{F}{A}$

ANSWERS TO EVALUATION

1. $t = \frac{d}{r}$
2. $z = 3A - x - y$
3. $D = 2h + d$
4. $S = \frac{ds}{D}$
5. $A = \frac{F}{P}$

ANSWERS TO APPLICATIONS

1. $x = 8 - \frac{4y}{3}$
2. $x = \frac{3y}{2.4}$
3. $R = \frac{V}{I}$
4. $C = \frac{1}{2\Pi f x_c}$
5. $C^\circ = K^\circ - 273^\circ$
6. $b = 2a - 1$
7. $h = \frac{3v}{s^2}$
8. $y = \frac{1}{a}$
9. $x = \frac{1}{m}$
10. $W = \frac{16\ DEl}{L}$

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #43

Performance Objective #43: Given a formula, solve for any variable in terms of the other variables in the formula.

1. If $3x + 4y = 24$, solve for x.

2. Given $\frac{2.4x}{3y} = 1$, solve for x.

3. The voltage V across a part of a circuit is given by the current I through that part of the circuit times the resistance R of that part. That is, $V = IR$. Suppose V and I are given but it is desired to find R. Solve for R.

4. Solve for C if $x_c = \frac{1}{2\pi fC}$

5. Given $K^\circ = C^{\circ\text{o}} + 273^\circ$, solve for C°.

6. $a = \frac{1 + b}{2}$, solve for b.

7. $V = \frac{s^2h}{3}$, solve for h.

8. $ay + a = 1 + a$, solve for y.

9. $m - mx = m - 1$, solve for x.

10. When a weight is placed at the center of a beam that is supported at both ends, the beam is deflected, or bent, downwards. The formula for the deflection D is given in terms of the weight W at the center of the beam and other variables:

$$D = \frac{WL}{16E1}$$

If a beam is deflected a certain amount and values for L, E, and 1 are known, then you must solve the formula for W in order to find out how much weight is on the beam. Solve the formula for W.

COMPETENCY #31

Solve formulas.

PERFORMANCE OBJECTIVE #44

Given a formula and values for all but one variable, solve the formula to find the value of the remaining variable.

INSTRUCTIONAL ACTIVITIES

Sample Item

Find F when C is 40: $F = (9/5 \times C) + 32$
(ans: 104)

Notes

General: Although students should be required to memorize only the most commonly used formulas, learning to solve formulas is one of the most important skills encountered in a vocational math course.

Air Conditioning/Heating: The air conditioning and heating technician or service person must be able to use formulas to solve problems in all areas such as plumbing, sheet metal, piping, refrigeration cycle servicing, electrical and movement and control of air. Problems using formulas are solved to aid in troubleshooting and then repairing.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 73-97.

EVALUATION

1. Find D when $h = 0.25$ and $d = 5.25$: $h = \frac{D - d}{2}$
2. Find H when $P = 1.125$: $H = \frac{P}{2} + 0.01$
3. Find h when $V = 36$, $l = 6$, and $w = 2$: $V = lwh$
4. Find s when $S = 300$, $D = 10$, and $d = 2$: $\frac{s}{S} = \frac{D}{d}$

ANSWERS TO EVALUATION

1. 5.75
2. 0.5725
3. 3
4. 1500

ANSWERS TO APPLICATIONS

1. 675 CFM
2. $R_T = 3.3$ ohms
3. 401,920 cubic in. per min.
4. $W = 12'$
5. $A = 1{,}589.625$ sq. in.
6. $h = 22$
7. 1.000"
8. $x = 4$
9. $z = 9.53$
10. $y = 5$

Formulas Used in the Air Conditioning Trade

A. Temperatures

$°F = (9/5 \times C) + 32$

$°C = 5/9 \times (F - 32)$

$°R = °F + 460$

$°K = °C + 273$

B. Area

rectangle: $A = l \times w$

circle: $A = \Pi x r^2$

or $A = \frac{\Pi x\ d^2}{4}$

C. Circumference

$C = \Pi d$

D. Volume

rectangle prism (box): $V = \frac{lwh}{2}$

cylinder: $V = \Pi r^2 h$

or $V = \frac{\Pi \times d^2 h}{4}$

E. Compressor Displacement (CD)

$CD = \Pi r^2 LMN$

M = No. of Cylinders
N = Speed in RPM
L = Length of Stroke
r = radius of cylinder

F. Boyle's Gas Law

$P_1 V_1 = P_2 V_2$

or

$\frac{P_1}{P_2} = \frac{V_2}{V_1}$

G. Charles' Gas Law

$V_1 T_2 = V_2 T_1$

or

$\frac{V_1}{V_2} = \frac{T_1}{T_2}$

H. Gay-Lussac's Gas Law

$P_1 T_2 = P_2 T_1$

or

$\frac{P_1}{P_2} = \frac{T_1}{T_2}$

I. Combined Gas Law

$P_1 V_1 T_2 = P_2 V_2 T_1$ or $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

J. Perfect Gas Law

$PV = WRT$

K. Pressure and Force

$P = F/A$

L. Compression Ratio (CR)

$$CR = \frac{\text{Head Pressure (PSIA)}}{\text{Suction Pressure (PSIA)}}$$

M. Density (D)

$D = W/V$

N. Specific Volume (SV)

$$SV = \frac{V}{W} \quad D = \frac{1}{SV}$$

O. Specific Gravity (SG)

$$SG = \frac{W_s \text{ (Weight of Substance)}}{W_w \text{ (Weight of Water)}}$$

P. Air Flow

$$CFM = \frac{q \text{ (Sensible Heat)}}{1.08 \times TD \text{ (Temp Difference)}}$$

$$A\text{(Area of Duct)} = \frac{CFM}{V \text{ (Velocity)}}$$

$$N \text{ (Air Changes per hour)} = \frac{60 \times CFM}{V \text{ (Space Volume)}}$$

Q. Fan Speed (S)

$$S\text{(RPM)} = \text{Speed of Motor} \times \frac{\text{Dia. of Driver}}{\text{Dia. of Driver}}$$

$$S = RPM \times \frac{D_1}{D_2}$$

R. Heat

$q = W \times SH \times TD$

$q = BTU$

SH = Specific Heat

TD = Temp. Difference

S. Power (P)

$$P = \frac{F \times D}{T} = \frac{\text{Force} \times \text{Distance}}{\text{Time}}$$

$$HP = \frac{\text{Wt. in lbs.} \times \text{Distance in feet}}{\text{Time in Minutes} \times 33{,}000}$$

T. Pressure in Duct

$$P_T = P_v + p_s \qquad P_v = \frac{V^2}{4005}$$

$$V = 1{,}096 \sqrt{P_v \times V} \qquad V = 4{,}005 \sqrt{P_v}$$

U. Electrical

Use the attached PIRE Wheel to develop these formulas.

Ohms Law and Watts Law

$P = El$ $P = 1^2R$ $P = E^2/R$

$I = E/R$ $I = P/E$ $I = P/R$

$R = E/I$ $R = E^2/P$ $R = \frac{P}{I^2}$

$E = P/I$ $E = \sqrt{PR}$ $E = IR$

$1_T = I_1 + I_2 + I_3 \ldots$ $R_T = \frac{R_1 + R_2}{R_1 \times R_2}$

$E_T = E_1 + E_2 + E_3 \ldots$

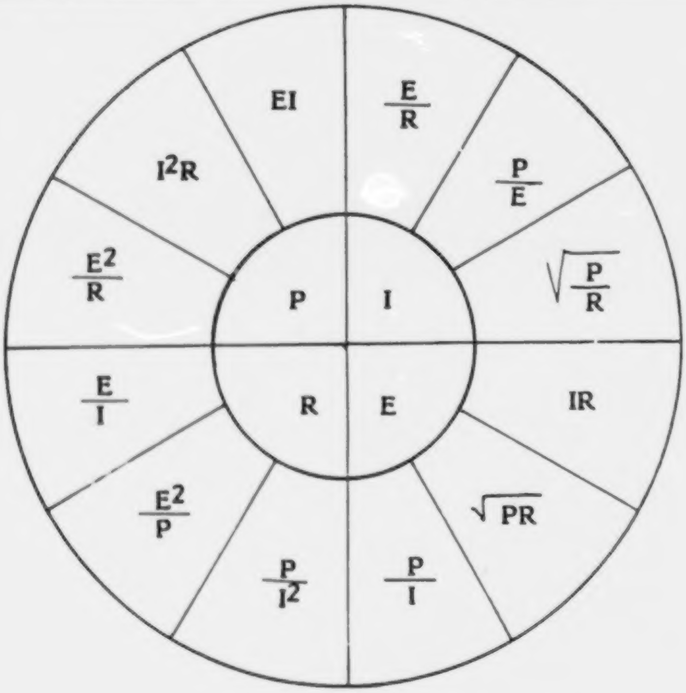
$R_T = R_1 + R_2 + R_3 \ldots$ $R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$

$P_T = P_1 + P_2 + P_3 \ldots$

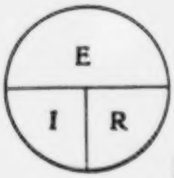
$P = E \times I \times PF$ $CT = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$

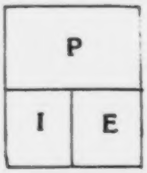
A device which shows the formula resulting from the combination of Ohm's Law and Watt's Law.

OHMS LAWS WATTS



EI
$\frac{E}{R}$
$\frac{P}{E}$
$\sqrt{\frac{P}{R}}$
IR
$\sqrt{PR}$
$\frac{P}{I}$
$\frac{P}{I^2}$
$\frac{E^2}{P}$
$\frac{E}{I}$
$\frac{E^2}{R}$
I^2R
P
I
R
E





I = CURRENT IN AMPERES
E = VOLTAGE IN VOLTS
R = RESISTANCE IN OHMS
P = POWER IN WATTS

PIRE WHEEL

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #44

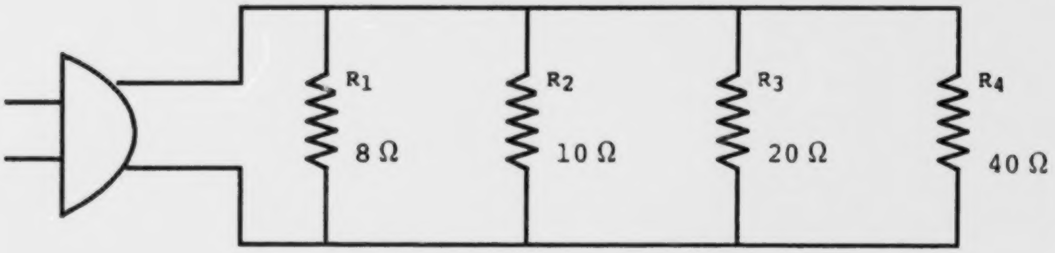
Performance Objective #44: Given a formula and values for all but one variable, solve the formula to find the value of the remaining variable.

1. A supply grill measures 30 inches by 6 inches with 90% free area. The velocity across the grill is 600 FPM (feet per minute). What is the volume of air in CFM (cubic feet per minute)?

   Given: $$CFM = \frac{A \times V}{144}$$

   A = area (sq. in.)
   V = Velocity FPM
   144 sq. in./sq. ft.

2. Calculate the total resistance (R_T) of the following diagram.



$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}}$$

3. A compressor has four cylinders. Each cylinder has a 4-inch bore and a 4-inch stroke and the speed is 2,000 RPM. What is the compressor displacement?

   $CD = \Pi \times r^2 \times L \times M \times N$ where

   r = radius of cylinder
   L = length of stroke
   M = no. of cylinders
   N = speed in RPM

Solve for the indicated variable:

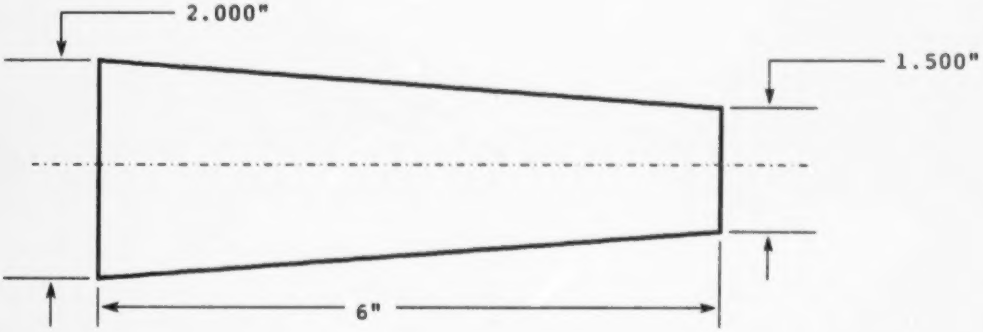
4. If $P = 21 + 2w$ and $P = 96'$; $1 = 36'$ --- find w.

5. If $A = \Pi r^2$ and $\Pi = 3.14$; $r = 22.5"$ --- find A.

6. If $V = lwh$ and $V = 4,224$; $l = 16$; $w = 12$ --- find h.

7. The machinist must determine the taper per foot by using the following formula.

$$\text{Taper per Foot} = \frac{(\text{Large Dia.} - \text{Small Dia.}) \times 12}{\text{Length of taper}}$$



8. $3X + 4Y = 24$. If Y is 3, then what is the value of X?

9. $5.3X + 2.9Y - 5.7Z = 100$. If X is 22 and Y is 13, then what is the value of Z? (Round to nearest hundreth.)

10. $\frac{2.5x}{5y} = 1$ If x = 10, what is y?

MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #32

Evaluate expressions with powers and roots.

PERFORMANCE OBJECTIVE #45

Given an expression with an exponent or radical, write its value without an exponent or radical.

INSTRUCTIONAL ACTIVITIES

Sample Item

Simplify:

a) 4^2 b) $\sqrt{25}$ (ans: a) 16, b) 5)

Notes

Radicals and exponents appear in many formulas used by vocational students. This would be a good time to continue with formula solving.

Even though students should be permitted to use the square root key on the calculator, they must know how to estimate square roots in order to check answers for reasonableness.

With tables and calculators readily available, there is little need for students to learn a long manual method of extracting roots.

Examples of formulas are:

1. $A = \Pi r^2$
2. $V = \Pi r^2 h$
3. $P = I^2 R$
4. $P = \frac{E^2}{R}$
5. $I = P/R$
6. $V = \frac{4 \Pi r^3}{3}$
7. $v = s^3$
8. $a^2 + b^2 = c^2$

REFERENCE TO TEXT

CAREER MATHEMATICS, page 384.

EVALUATION

Simplify:

1. 1.2^2 2. 4^3 3. $\sqrt{81}$ 4. $\sqrt[3]{125}$

ANSWERS TO EVALUATION

1. 1.44
2. 64
3. 9
4. 5

ANSWERS TO APPLICATIONS

1. a) 25
   b) 121
   c) 225
   d) 11.56
   e) 125
   f) 343
2. a) 8
   b) 13
   c) 19
   d) 1.4
   e) 3
   f) 12
3. V = 1500 FPM and P_v = 0.14 in. of water
4. 32.3 amps
5. 870 watts

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #45

Performance Objective #45: Given an expression with an exponent or radical, write its value without an exponent or radical.

1. Raise the following to the powers indicated.

a)	5^2	d)	3.4^2
b)	11^2	e)	5^3
c)	15^2	f)	7^3

2. Find these roots.

a)	$\sqrt{64}$	d)	$\sqrt{1.96}$
b)	$\sqrt{169}$	e)	$\sqrt[3]{27}$
c)	$\sqrt{361}$	f)	$\sqrt[3]{1728}$

3. 6,000 CFM of air is flowing through a 24 in. square duct. What is the velocity pressure (P_v)? (Round to the nearest hundreth.)

Given: $V = \frac{CFM}{A}$

V = Velocity in feet/min.
A = Area in sq. ft.
CFM = Cubic feet/min.

$$P_v = \left(\frac{V}{4005}\right)^2$$

4. An electric furnace uses 10,000 watts of power. The resistance of the electrical element is 9.6 ohms. What is the current flow? (Round to the nearest tenth.)

Given: $I = \sqrt{\frac{P}{R}}$

I = Current
P = Power
R = Resistance

5. An outdoor unit of a heat pump is located 300 feet from the electrical distribution panel. The resistance of the wire from the panel to the outdoor unit is 0.85 ohms and the current is 32 amps. What is the power loss in the line? (Round to the nearest watt.)

Given: $P = I^2R$

I = Current
P = Power
R = Resistance

COMPETENCY #33

Read and write numbers in scientific notation.

PERFORMANCE OBJECTIVE #46

Given a list of numbers written in scientific notation and a list of numbers in expanded form, match the scientific notation expression with its expanded form.

INSTRUCTIONAL ACTIVITIES

Sample Item

Match:

1. 1.5×10^{4} a) 0.00015
2. 1.5×10^{-4} b) 15,000

(ans: 1. b, 2. a)

Notes

Although scientific notation is not used in every vocational area, it is frequently encountered in technical writings and should be familiar to the student. Students must also be able to read answers on calculators when the display shows scientific notation. Give the students problems such as 999,999 x 999 or 5 ÷ 6,666,666 and ask them to explain the calculator display.

REFERENCE TO TEXT

None

EVALUATION

Match:

1. 2.36×10^{5} a) 0.000236
2. 2.36×10^{-3} b) 0.00236
3. 2.36×10^{-4} c) 236,000
4. 2.36×10^{4} d) 23,600

ANSWERS TO EVALUATION

1. c
2. b
3. a
4. d

ANSWERS TO APPLICATIONS

1. 1.5×10^{-4}
2. 4.27×10^{6}
3. 2.5×10^{7}
4. 7.25×10^{-3}
5. 4.0×10^{-4}
6. 6.7×10^{4}
7. 8.0×10^{5}
8. 5.0×10^{-1}
9. 3.02×10^{-3}
10. 4.05×10^{5}
11. a) 5
    b) 1
    c) 2
    d) 6
    e) 7
    f) 3
    g) 4

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #46

Performance Objective #46: Given a list of numbers written in scientific notation and a list of numbers in expanded form, match the scientific notation expression with its expanded form.

Write these numbers in scientific notation:

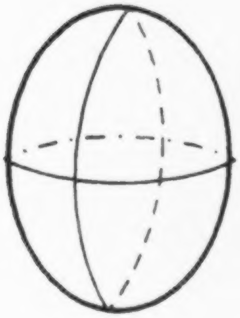
1. 0.00015 inches
2. 4,270,000 pounds
3. $25,000,000
4. 0.00725 inches
5. 0.0004 grams
6. 67,000 kilometers
7. 800,000 gallons
8. 0.5 millimeters
9. 0.00302 inches
10. $405,000
11. Match:

    a) 31,000
    b) 4,230,000
    c) .00423
    d) .000926
    e) 9.260
    f) .031
    g) 42.300

    1. 4.23×10^{6}
    2. 4.23×10^{-3}
    3. 3.1×10^{-2}
    4. 4.23×10^{1}
    5. 3.1×10^{4}
    6. 9.26×10^{-4}
    7. 9.26×10^{0}

section V

ratio, proportion and percent



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #34

Write and simplify ratios.

PERFORMANCE OBJECTIVE #47

Given a verbal statement containing a ratio, write the ratio in numerical form and simplify it.

INSTRUCTIONAL ACTIVITIES

Sample Item

For every one part chemical, put 3 parts water. (Write the ratio of chemical to water.) (ans: 1/3)

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 125-127, 140-141, 148-149, 370.

EVALUATION

1. A chemical costs $4.38 for 3 ounces. Write the ratio for the cost per ounce.
2. Two gears are in an 8 to 12 ratio. Write this ratio.
3. The drawing was 1.5 centimeters for every 18 meters. Write this ratio.
4. We drove 523 miles and used 13.3 gallons of gas. How many miles per gallon is this?

ANSWERS TO EVALUATION

1. $1.46/1 oz.
2. 2/3
3. 1/12
4. 39.3 mpg

ANSWERS TO APPLICATIONS

1. 22/1
2. 3/1
3. 6/1
4. 3/1
5. 1/125
6. 3/100
7. 2/1
8. 5/1
9. 1/4
10. 3.94/1

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #47

Performance Objective #47: Given a verbal statement containing a ratio, write the ratio in numerical form and simplify it.

Write the following ratios in numerical form and simplify them.

1. Two gears have 88 teeth and 4 teeth respectively.
2. A compressor has 129 cubic inches of volume at the beginning of compression and 43 cubic inches of volume after compression.
3. One pulley is running at 540 RPM and is belted to another running at 90 RPM.
4. If a laborer mixes 18 shovels of sand with 6 shovels of mortar mix, what is the ratio of sand to mortar mix?
5. A contractor finds that it takes 8 bags of mortar mix to lay 1,000 bricks. What is the ratio of bags of mortar mix to bricks?
6. A roofer finds that it takes 27 bundles of shingles to cover 900 sq. ft. of roof. What is the ratio of bundles to sq. ft.?
7. When making punch you use 4 gallons of fruit juice to 2 gallons of water. What is the ratio you use when making punch?
8. If a welder uses 25 pounds of oxygen to 5 pounds of acetylene, what is the ratio of the gases?
9. A motor with a 3-inch pulley is driving a fan with a 12-inch pulley. What is the ratio of the motor to the fan?
10. A compressor has a suction pressure of 68.3 PSIG (83.0 PSIA) and a discharge pressure of 269.3 PSIG (285 PSIA). What is the compression ratio?

    Given: $$CR = \frac{\text{Discharge Pressure (PSIA)}}{\text{Suction Pressure (PSIA)}}$$

COMPETENCY #35

Write and solve proportions.

PERFORMANCE OBJECTIVE #48

Given a verbal problem, write a proportion to solve the problem.

INSTRUCTIONAL ACTIVITIES

Sample Item

Write the proportion to solve this problem.

A nickel weighs 5 grams. A nickel is made by adding 3 grams of copper for every 1 gram of nickel. How much nickel is in a nickel?

(ans: 1/4 = X/5)

Notes

Students sometimes find writing proportions easier if they first write the quantities involved as a ratio in words. For example, the ratio for the sample item above would be nickel to total weight.

After the students work on writing proportions, use these proportions for teaching solving. (Performance Objective #44)

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 136-137, 144-147.

EVALUATION

Write proportions that could be used to solve these problems.

1. A cubic foot of water weighs 62.4 pounds and is about 7.5 gallons. How much does one gallon of water weigh?
2. A machine produces 280 pieces in 3.5 hours. How long does it take to produce 800 pieces?
3. An engine uses 6 gallons of gasoline to run 7 hours. If it runs at the same speed, how many gallons will it use in 16 hours?
4. A 320' roll of wire weighs 30 pounds. How many feet of the same wire are in a roll weighing 25 pounds?

ANSWERS TO EVALUATION

1. $\frac{62.4}{7.5} = \frac{x}{1}$ or $\frac{62.4}{x} = \frac{7.5}{1}$

2. $\frac{280}{3.5} = \frac{800}{x}$ or $\frac{280}{800} = \frac{3.5}{x}$

3. $\frac{6}{7} = \frac{x}{16}$ or $\frac{6}{x} = \frac{7}{16}$

4. $\frac{320}{30} = \frac{x}{25}$ or $\frac{320}{x} = \frac{30}{25}$

ANSWERS TO APPLICATIONS

1. $\frac{n}{17000} = \frac{8}{1000}$

2. $\frac{n}{800} = \frac{7}{1}$

3. $\frac{n}{925} = \frac{1}{100}$

4. $\frac{5}{1} = \frac{n}{8}$

5. $\frac{540}{x} = \frac{2}{1/3}$

6. $\frac{1.5}{1} = \frac{x}{10.5}$

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #48

Performance Objective #48: Given a verbal problem, write a proportion to solve the problem.

1. If it takes 8 bags of mortar mix to lay 1,000 bricks, how many bags of mortar mix would one order to lay 17,000 bricks?

2. If 7 bricks cover one square foot of wall space, how many bricks would be needed to cover 800 square feet of wall space?

3. If one square of shingles covers 100 square feet, how many squares would one order to cover 925 square feet?

4. A coil cleaning liquid is mixed using a ratio of 5 parts of water to 1 part of cleaner. If 8 oz. of cleaner is used, how much water must be added?

5. If you have 540 yards of red fabric and each pattern uses 2 yards of red fabric and 1/3 yard of interfacing material, how much interfacing material would you need to make up all your red fabric?

6. A vertical fillet weld made with a weave bead requires 1 1/2 times as much rod as a flat fillet weld. A 24-inch long flat fillet weld requires 10 1/2 arc rods. How many rods will be required to make a vertical weld of the same length?

COMPETENCY #35

Write and solve proportions.

PERFORMANCE OBJECTIVE #49

Given a proportion with one unknown, solve the proportion.

INSTRUCTIONAL ACTIVITIES

Sample Item

Solve: $\frac{x}{7} = \frac{2}{3.5}$ (ans: $x = 4$)

Notes

When proportions have whole numbers or decimal components, a calculator is helpful for solving. When common fractions are used, however, answers should be given as common fractions.

Proportions are commonly used to determine cost or weight of material when dealing in smaller quantities than when the material was purchased.

REFERENCE TO TEXT

CAREER MATHEMATICS, page 371.

EVALUATION

Solve:

1. $\frac{1/8}{20} = \frac{x}{250}$
2. $\frac{7.2}{50} = \frac{30}{x}$
3. $\frac{3/8}{x} = \frac{1.5}{15.6}$
4. $\frac{6}{30} = \frac{0.1}{x}$

ANSWERS TO EVALUATION

1. 25/16 or 1 9/16 or 1.5625
2. 208.3
3. 3.9
4. 0.5

ANSWERS TO APPLICATIONS

1. N = 2
2. N = 35
3. N = 108
4. 39 lbs.
5. $6.59
6. $2.49
7. 56.28 liters
8. 20 liters of solution

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #49

Performance Objective #49: Given a proportion with one unknown, solve the proportion.

Solve the following proportions:

1. $\frac{N}{8} = \frac{14}{56}$

2. $\frac{5}{7} = \frac{N}{49}$

3. $\frac{5}{9} = \frac{60}{N}$

4. If 125 ft. of copper tube weighs 13 lbs., how much does 375 feet weigh?

5. If 30 lbs. of R22 refrigerant costs $42.97, what does 4.6 lbs. cost?

6. If sheet metal costs $13.27 for a 4 ft. x 8 ft. piece, what will a 3 ft. x 2 ft. piece cost?

7. An engine running at a constant speed uses 134 milliliters of gasoline per minute. How many liters of gasoline would this engine burn in 7 hours?

8. A solution contains 20% acid and 80% water. How many liters of solution can be made with 4 liters of acid?

COMPETENCY #36

Interpret and use scale drawings.

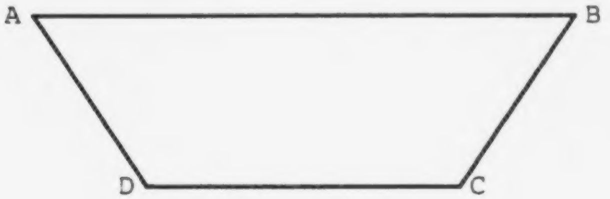
PERFORMANCE OBJECTIVE #50

Given a scale drawing, write and solve a proportion to find unknown lengths.

INSTRUCTIONAL ACTIVITIES

Sample Item

On this drawing of a lot, 1 cm = 15 m. How long is side AB in meters? (ans: 118 m)



Notes

Give the students maps or actual scale drawings and have them measure the lengths on the drawings and then compute the actual length. Another activity is to have the students do scale drawings of their classroom or some part of the school.

House plans are usually drawn to a scale of 1/4" = 1'0". This scale allows the construction worker to interpret information from a sheet much smaller than the structure he/she is building. It would be very impractical, if not impossible, to draw a building plan the actual size of the building.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 130-134.

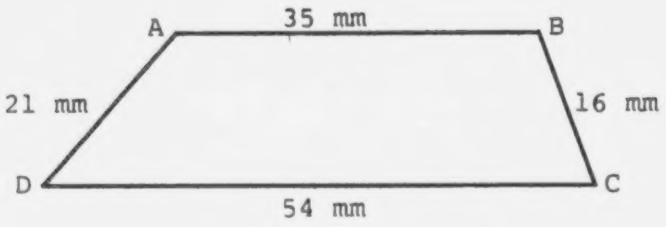
EVALUATION

1. Find:

a) AB

b) DC

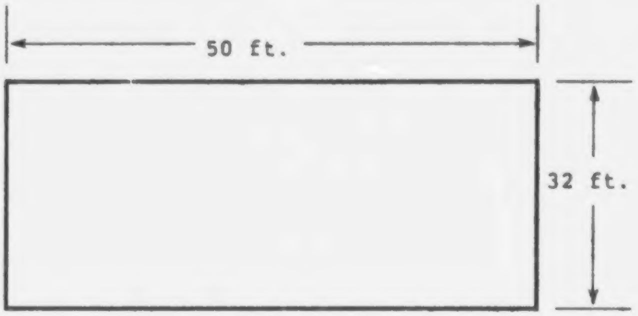
Scale 1 cm = 12 m


A
35 mm
B
21 mm
16 mm
D
C
54 mm

2. This building must be drawn to a scale of 1 ft. = 1/8 in.

a) What length on the scale drawing will represent the length?

b) What length on the scale drawing will represent the width?



ANSWERS TO EVALUATION

1. a) 42 m
   b) 64.8 m
2. a) 6 1/4 in.
   b) 4 in.

ANSWERS TO APPLICATIONS

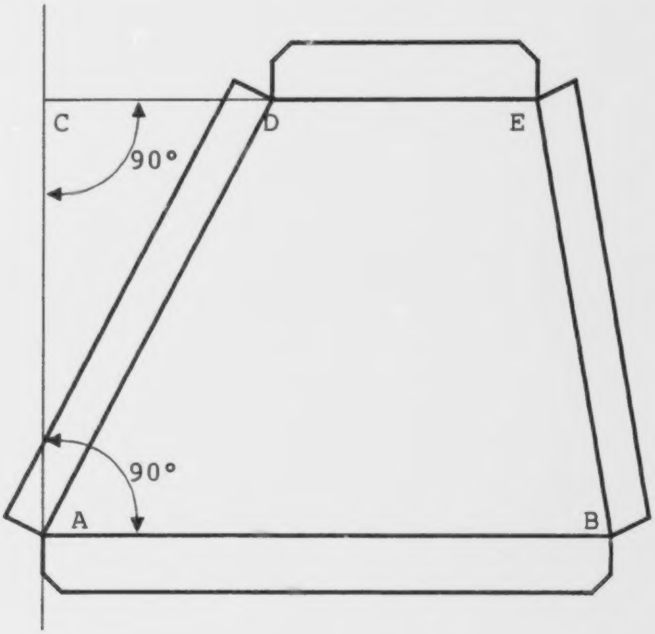
1. 6.8 cm
2. 21.3 cm
3. 19 3/4"
4. A = 48'
   B = 14'
   C = 39'
5. A = 7'0"
   B = 14'0"
   C = 6'0"
   D = 8'0"
6. A = 11 ft.
   B = 11 1/2 ft.
   C = 12 ft.
   D = 8 1/2 ft.
   E = 16 ft.

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #50

Performance Objective #50: Given a scale drawing, write and solve a proportion to find unknown lengths.

1. If dimension AB is 6.8 cm and DE is 3.3 cm, what will be the dimension of DE if AB is 14 cm?

2. If dimension AB is 6.8 cm and BE is 5.8 cm, what will be the dimension of AB if BE is 18.2 cm?



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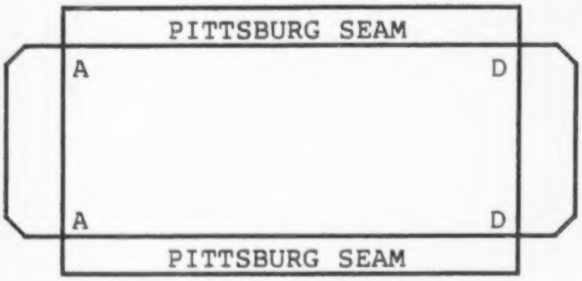
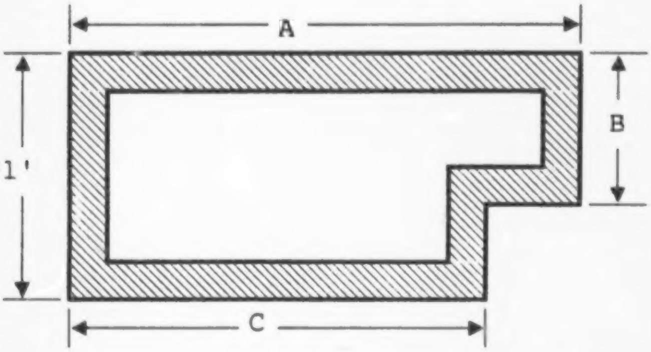
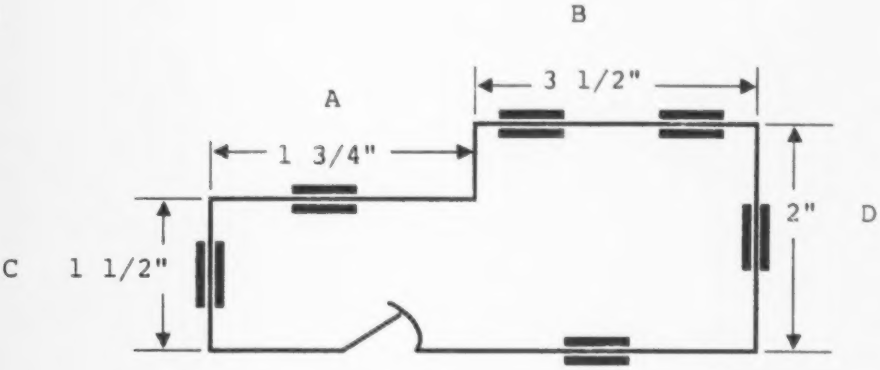
3. Dimension AD is two times larger than AA. What will be the dimension of AA if AD is 39 1/2" long?


PITTSBURG SEAM
A
D
A
D
PITTSBURG SEAM

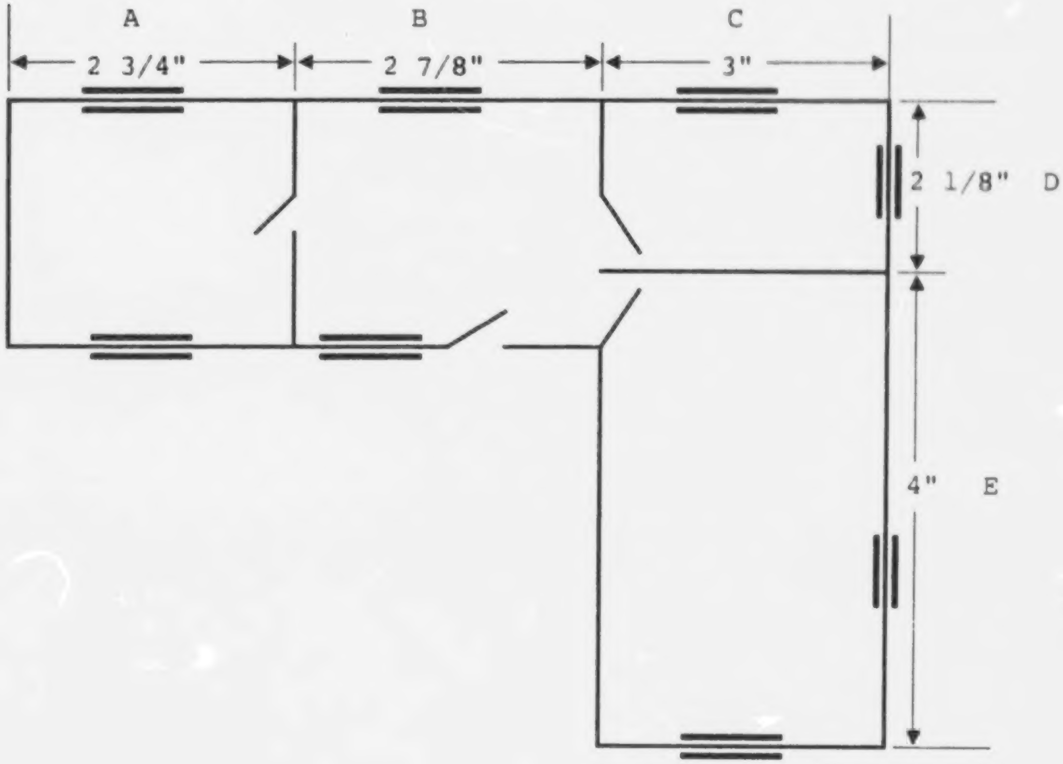
4. Using a ruler and proportions, find the dimensions A, B, and C.
Scale: 1/8" = 2'



5. Determine the length of sides A, B, C and D. The actual measurements are shown on the drawing. Scale: 1/4' = 1'0"


B
A
3 1/2"
1 3/4"
C
1 1/2"
2"
D

6. Below is a scale drawing of a floor plan of a house. The scale is 1/4" = 1'0". The measurements on the drawing are actual measurements. What lengths do these measurements represent?



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COMPETENCY #37

Write equivalent forms of percents, decimals and common fractions.

PERFORMANCE OBJECTIVE #51

Given a percent, write the equivalent common fraction and decimal.

INSTRUCTIONAL ACTIVITIES

Sample Item

Write as a common fraction and decimal: 80%
(ans: 80/100 = 4/5 and 0.80 or 0.8)

Notes

Performance Objectives #51 - 53 should be taught together and not in isolation. Stressing that percent is a ratio whose second component is 100 makes all the conversions easier. Have the students write this ratio first and then write the decimal equivalent.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 374-375.

EVALUATION

Write each percent as a common fraction and a decimal fraction.

1. 4 1/2%
2. 130%
3. 86%
4. 7%

ANSWERS TO EVALUATION

	Fraction	Decimal
1.	$\frac{4\ 1/2}{100} = \frac{9}{200}$	0.04 1/2 or 0.045
2.	$\frac{130}{100} = \frac{13}{10}$	1.3
3.	$\frac{86}{100} = \frac{43}{50}$	0.86
4.	$\frac{7}{100}$	0.07

ANSWERS TO APPLICATIONS

1. a) 0.20, 1/5
   b) 0.375, 3/8
   c) 0.0325, 13/400
2. 0.20, 1/5
3. 7/20, 0.35
4. 1 21/50 or 71/50, 1.42

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #51

Performance Objective #51: Given a percent, write an equivalent decimal and common fraction.

1. Write the equivalent decimal and common fraction for the following percents.

    a) 20%

    b) 37 1/2%

    c) 3 1/4%

2. In determining the amount of lumber needed for a construction project, 20% is allowed for waste in cutting. What decimal and common fraction represent this amount?

3. On a certain job the materials will account for 35% of the total cost. Write this percent as a common fraction and a decimal fraction.

4. Last quarter's production at Smith's Plant was 142% of the previous quarter. Write this percent as a common fraction and a decimal fraction.

COMPETENCY #37

Write equivalent forms of percents, decimals and common fractions.

PERFORMANCE OBJECTIVE #52

Given a decimal, write the equivalent common fraction and percent.

INSTRUCTIONAL ACTIVITIES

Sample Item

Write as a common fraction and percent: 0.16

(ans: $\frac{16}{100} = \frac{4}{25}$ and $\frac{16}{100} = 16\%$)

Notes

Students frequently have problems with moving decimals left and right when working with decimals and percents. Help the students rely on what they already know (how to read decimals) and the fact that percent is a ratio whose second component is 100. When writing equivalent forms, write the decimal first as a common fraction by writing it as it is read.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 363, 372.

EVALUATION

Write each of the following decimals as common fractions and percents.

1. 0.85
2. 0.06
3. 0.155
4. 3.5

ANSWERS TO EVALUATION

1. $\frac{85}{100} = \frac{17}{20}$ $\frac{85}{100} = 85\%$

2. $\frac{6}{100} = \frac{3}{50}$ $\frac{6}{100} = 6\%$

3. $\frac{155}{1000} = \frac{31}{200}$ $\frac{155}{1000} = \frac{15.5}{100}$ 15.5%

4. $\frac{3.5}{1} = \frac{7}{2}$ $\frac{3.5}{1} = \frac{350}{100} = 350\%$

ANSWERS TO APPLICATIONS

1. a) 37 1/2%, 3/8
   b) 33 1/3%, 1/3
   c) 6 1/3%, 63/1000
2. 3/50, 6%
3. 1/6, 16 2/3%
4. 289/1000, 28.9%
5. 10%, 1/10
6. 18%, 9/50
7. 71%, 5/7

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #52

Performance Objective #52: Given a decimal, write the equivalent common fraction and percent.

1. Express each decimal as a percent and a common fraction.

   a) 0.375

   b) 0.333

   c) 0.063

2. The slope of a road was given as 0.06. Write this slope as a common fraction and percent.

3. A gear ratio was given as 0.16 2/3. Write this ratio as a common fraction and a percent.

4. A batter has a batting average of 0.289. Write this average as a common fraction and a percent.

5. On a residence, .10 of the total cost is from carpentry labor. What percent and what common fractional part of the total is for carpentry?

6. In milling lumber, .18 is allowed for waste. Express this as a percent and as a common fraction.

7. A formula for a cleaning solution requires 40 parts per 100 parts water. What percent of the solution is water? What fractional part is water?

COMPETENCY #37

Write equivalent forms of percents, decimals and common fractions.

PERFORMANCE OBJECTIVE #53

Given a common fraction, write the equivalent percent and decimal fraction.

INSTRUCTIONAL ACTIVITIES

Sample Item

Write as a percent and a decimal: 3/4

(ans: 3/4 = x/100 = 75/100 = 75% or 0.75)

Notes

Since percent is a ratio whose second component is 100, common fractions may be changed to percents by writing a proportion and solving.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 363, 373.

EVALUATION

Write as percents and decimals:

1. 3/8
2. 1/5
3. 1/3
4. 5/4

ANSWERS TO EVALUATION

1. 3/8 = x/100 = 37.5/100 = 37.5%

   37.5/100 = 375/100 = 0.375

2. 1/5 = x/100 = 20/100 = 20%

   20/100 = 0.20

3. 1/3 = x/100 = 33 1/3/100 = 33 1/3%

   33 1/3/100 = 0.33 1/3

4. 5/4 = x/100 = 125/100 = 125%

   125/100 = 1.25

ANSWERS TO APPLICATIONS

1. a) 90%, 0.9

   b) 87 1/2%, 0.875

   c) 6 1/4%, 0.0625

2. 95%, 0.95

3. 72 8/11%, 0.73

4. 12 1/2%, 0.125

5. 0.167, 16.7%

6. 0.1, 10%

7. .2, 20%

8. a) 0.05, 5%

   b) 0.067. 6.7%

   c) 0.083, 8.3%

   d) 0.053, 5.3%

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #53

Performance Objective #53: Given a common fraction, write the equivalent percent and decimal fraction.

1. Express each common fraction as a percent and decimal fraction.

   a) 9/10

   b) 7/8

   c) 1/16

2. On a given day 19/20 of the employees were present. Write this common fraction as a percent and a decimal.

3. The center made 8 of 11 free throws attempted. Write this ratio as a percent and a decimal.

4. Many architects charge a fee of 1/8 the total cost of a building for their services of planning, supervising and consultations. Write this common fraction as a percent and a decimal.

5. In addition to labor and materials cost, a contractor added 1/6 the cost of labor and materials for overhead and profit. What is the decimal equivalent and percent that 1/6 represents? (Round off answer to three decimal places.)

6. The town of Centerville approved 1/10 of the budget for essential services such as garbage collection, street cleaning, water and sewer services, maintenance, etc. Express this amount as a decimal and as a percent.

7. In determining the amount of lumber needed for sheathing a roof, the contractor added 1/5 to the roof area. Express 1/5 as a decimal and as a percent.

8. The general contractor's bid shows the following costs plus profits added by the subcontractor. Express as decimals and percents.

Subcontractor	Cost	Profit Added
Plumbing	$ 6,250	1/20
Masonry	$ 8,490	1/15
Electrical	$ 3,056	1/12
Heating	$ 2,175	1/19

COMPETENCY #38

Solve percent problems.

PERFORMANCE OBJECTIVE #54

Given a percent problem, find the missing rate, base or part.

INSTRUCTIONAL ACTIVITIES

Sample Item

A job cost $4,200. Of this amount 36% was materials. How much did the materials cost? (ans: 36% of $4,200 = $512)

Notes

Many students have trouble translating the words in a percent problem to a "formula". To help with this, have the students read the problem and write the information in the form: ____________% of ________________ = ______________. Once this translation is made, writing a proportion or algebraic equation is simple.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 54-61, 376-378.

EVALUATION

Solve these problems:

1. A welder making $8.15 an hour receives a 4% raise. What is the new hourly rate?
2. A 4-foot piece of metal expands 0.375 inches. What percent did it expand?
3. A piece of machinery is insured for $40,000, which is 80% of its replacement cost. What is the replacement cost?
4. In making plate glass, 72% of the ingredients is sand. How much sand is needed to make 125 kilograms of plate glass?

ANSWERS TO EVALUATION

1. $8.48 per hour
2. 0.8%
3. $50,000
4. 90 kg

ANSWERS TO APPLICATIONS

1. $35,556.40
2. 73.5%
3. $9.00
4. 58.9 oz.
5. 2.61 HP
6. 32%
7. 225 hrs.
8. $70.37
9. $450.00
10. 0.25%
11. 5%
12. a) $4.77
    b) $5.06
13. 262 sq. ft.
14. $4,091.22
15. $2,056.56
16. 5,265 sq. ft.
17. 21%
18. 8.0%
19. $4.75 saved and $232.81 paid

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #54

Performance Objective #54: Given a percent problem, find the missing rate, base or part.

1. In preparing a bid a contractor finds that the materials will cost $32,324. However, the contractor needs to allow 10% for inflation. How much should be figured for materials in preparing the bid?

2. The materials for a house cost $35,000. The labor cost $12,600. What percent of the total did the materials cost?

3. The brick masons want a 20% increase in salary. Their current hourly wage is $7.50. What would be the new hourly wage?

4. Solder is composed of 95% tin and 5% antimony. What is the weight of tin if a roll of solder weighs 62 oz?

5. An electric motor is listed as 3 HP but is only 87% efficient. What horsepower does it deliver?

6. A compressor costs $189.20 and the dealer will sell the compressor to a service person for $128.80. What is the rate of discount?

7. A local manufacturing manager stated that he had a job requiring 1,800 hours to complete and that 12 1/2% of the time was to be spent on a grinding operation. This operation amounted to how many hours?

8. A tool and supply company offered a 12% discount on orders of $100 or more. What would the discount be for an order of $586.40?

9. A machinist sold a box of tools for $292.50. If this was 65% of the original cost, what was the original cost?

10. In a machine manufacturing plant, 24 of the last 9,600 hours were lost due to accidents. What percentage of time was lost?

11. A local manufacturer produced 2,460 machine parts. Of these, 123 were defective. What was the percentage of defective parts?

12. A machine shop student was hired by a local manufacturer at the rate of $4.50 per hour. At the end of 30 days the student was given a 6% raise. At the end of 90 days the student was given another 6% raise.

   a) What was the student's hourly rate at beginning of the 2nd month?
   b) What was the student' hourly rate at the start of the 91st day?

13. Many contractors allow 10% for waste when determining the amount of sheathing needed for a roof of tongue and groove boards. If the roof area is 2,620 sq. ft., how many square feet must be added for waste?

14. The carpentry subcontractor is allowed 21% of the total labor cost of a residence construction. The total labor cost is $19,482. How much is allowed for carpentry?

15. The Smith family was told by a local painter that he/she usually paints house exteriors for the cost of materials plus a fee of 14% of the cost. How much should the Smith family expect to pay for painting their house if the cost of materials is $1,804?

16. An ordinance in the town of Mayberry states that a residence must not cover more than 45% of the lot upon which it is constructed. What is the maximum size house (sq. ft.) that can be constructed on a lot 150 ft. long by 78 ft. wide?

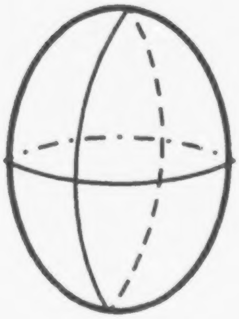
17. A bricklayer charges a homeowner $1,046 for a job. This amount included a profit of $219.66. What is the bricklayer's rate of profit?

18. The excavation charges for a $27,500 house come to $2,187.00. What percent of the total cost (to nearest 1/2 percent) is this amount?

19. If there is a 2% discount for payment within 10 days of receipt of invoice and the invoice amount is $237.56, how much money could you save if you paid by day 5? How much money should you pay?

section VI

graphs and tables



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #39

Locate points in a coordinate plane.

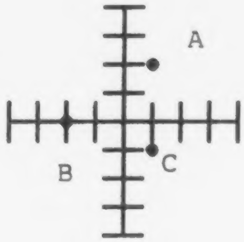
PERFORMANCE OBJECTIVE #55

Given a list of ordered pairs and a set of points in a coordinate plane, match one set of ordered pairs to the points.

INSTRUCTIONAL ACTIVITIES

Sample Item

1. (-2,0)	1. B
2. (1,-1)	2. C



Notes

The concepts of ordered pairs and locating points in a plane are important even though their application is not always direct in vocational areas. Put the most emphasis on points in the first quadrant. You may wish to use maps to demonstrate locating points using a grid system.

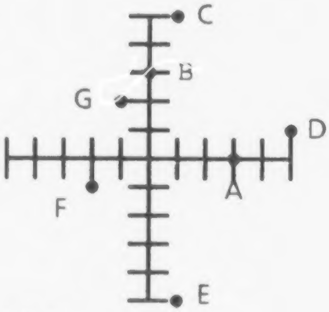
REFERENCE TO TEXT

None

EVALUATION

Find the point on the graph that corresponds to each ordered pair.

1. (-1,2)
2. (0,3)
3. (1,-5)
4. (5,1)



ANSWERS TO EVALUATION

1. G
2. B
3. E
4. D

ANSWERS TO APPLICATIONS

1. A) B
    B) F
    C) A
    D) C
    E) D
2. A) (-20,2)
    B) (15,4)
    C) (30,2)
    D) (40,6)
    E) (55,3)
    F) (60,-3)
    G) (40,-5)
    H) (20,0)
    I) (0,-3.5)

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #55

Performance Objective #55: Given a list of ordered pairs and a set of points in a coordinate plane, match one ordered pair to the points.

1. Name the point paired with each ordered pair.

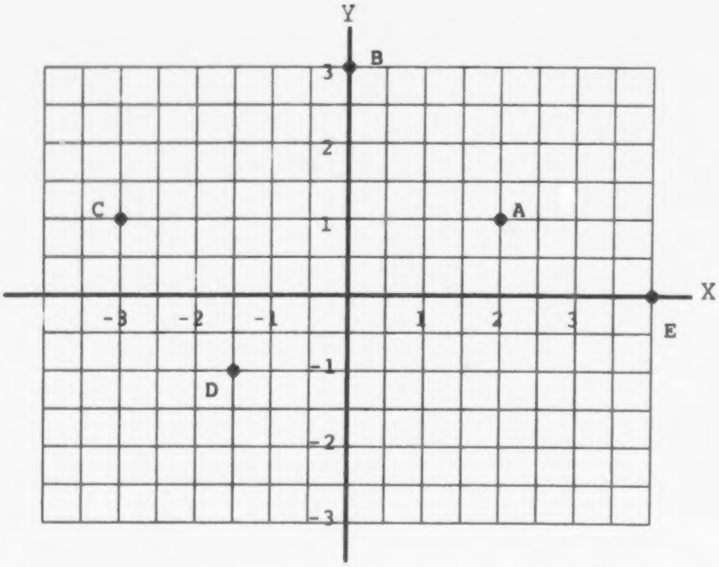
   a. (0,3)

   b. (4,0)

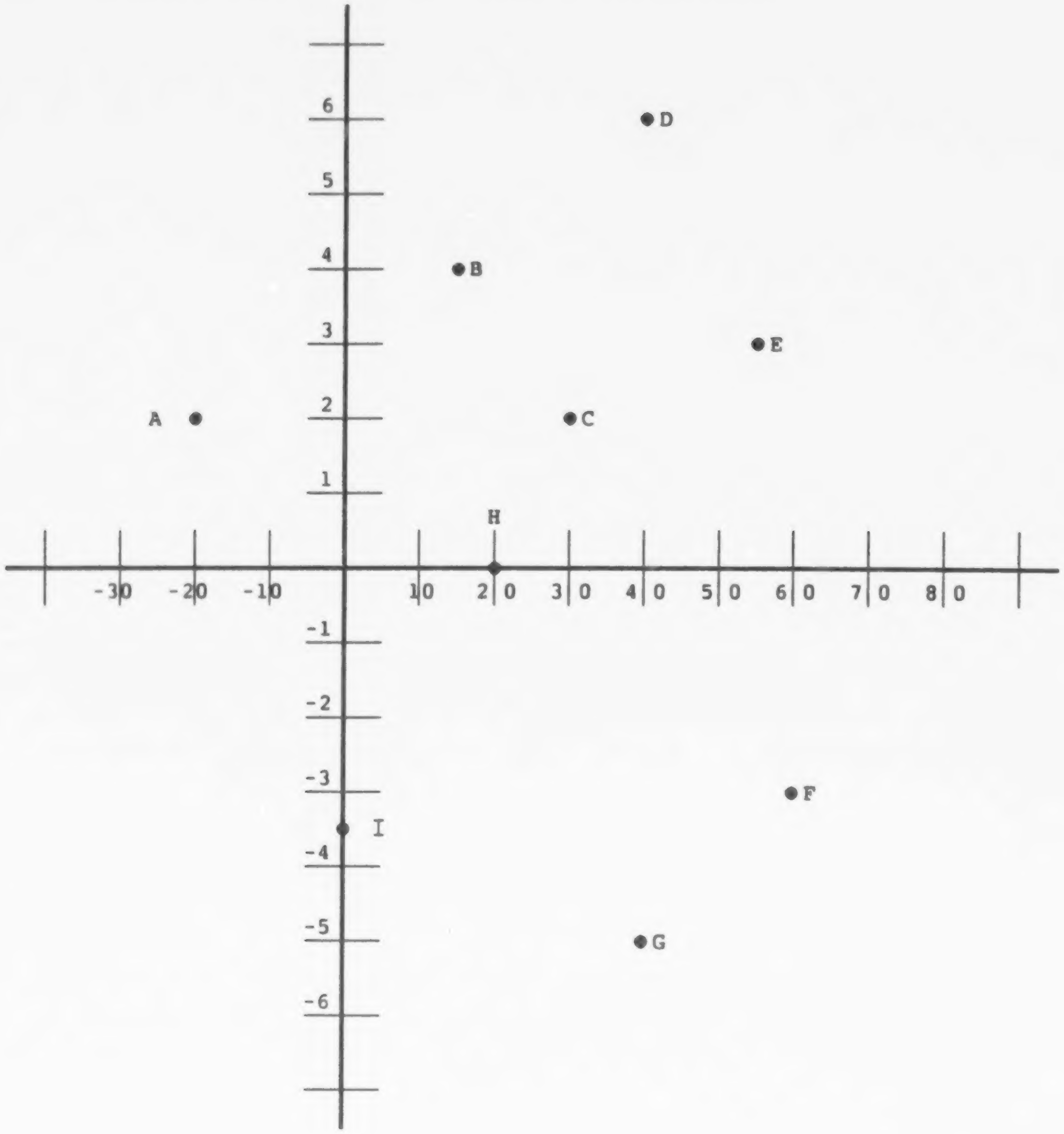
   c. (2,1)

   d. (-3,1)

   e. (-1.5,-1)



2. Identify points A-I as order pairs (x,y).



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #40

Read information from a table.

PERFORMANCE OBJECTIVE #56

Given a table, answer questions pertaining to the information in the table.

INSTRUCTIONAL ACTIVITIES

Notes

Collect and use tables that are actually used in the trades and industries areas. Reading mathematical tables is also an important skill. Tables are used because much vital information can be recorded in a small space and in a format that is easy to access.

REFERENCE TO TEXT

None

EVALUATION

	Amarillo, TX	Atlanta, GA	Baltimore, MD	Birmingham, AL.	Bismark, ND
Albuquerque, New Mexico	284	1381	1829	1251	1088
Amarillo, Texas	0	1097	1554	967	948
Atlanta, Georgia	1097	0	645	150	1495
Austin Texas	483	919	1519	769	1324
Baltimore, Maryland	1554	645	0	773	1499

1. How far is it from Atlanta, Georgia, to Amarillo, Texas?
2. Which two cities are 773 miles apart?
3. Which city is nearest Birmingham, Alabama?
4. How far is it from Austin, Texas, to Baltimore, Maryland, if the person drives through Atlanta, Georgia?

ANSWERS TO EVALUATION

1. 1,097 miles
2. Birmingham and Baltimore
3. Atlanta
4. 1,564 miles

ANSWERS TO APPLICATIONS

1. a) 13.6 HTM
   b) 2.3 HTM
   c) 3.3 HTM
2. a) 9.2 PSIG
   b) 2.7 PSIG
   c) 5°F
   d) -25°F
3. a) 0.042"
   b) 1.025"
   c) 0.1982 lbs.
   d) 0.5197 sq. ft.
4. a) .6777
   b) 0.4488
   c) 0.3611
5. a) 14%
   b) 20%
   c) 24%
   d) 9%
   e) 10 1/2"
   f) 32%

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #56

Performance Objective #56: Given a table, answer questions pertaining to the information in the table.

Wood Frame and Masonry Walls and Partitions. Factors include heat loss due to transmission only

Winter Temperature Difference		30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	UT	UE
No. 12 Wood Frame Exterior Walls With Sheathing and Siding or Brick Veneer, or Other Exterior Finish.																		
Cavity Insul	Sheathing	(Btuh per sq ft)																
A. None	½" Gypsum Brd (R-0.5)	8.1	9.5	10.8	12.2	13.6	14.9	16.3	17.6	19.0	20.3	21.7	23.0	24.4	25.7	27.1	0.271	
B. None	½" Asphalt Brd (R-1.3)	6.5	7.6	8.7	9.8	10.8	11.9	13.0	14.1	15.2	16.3	17.4	18.4	19.5	20.6	21.7	0.217	
C R-11	½" Gypsum (R-0.5)	2.7	3.1	3.6	4.0	4.5	4.9	5.4	5.8	6.3	6.7	7.2	7.6	8.1	8.5	9.0	0.090	
D. R-11 R-11 R-13	½" Asphalt Brd (R-1.3) ½" Bead Brd (R-1.8) ½" Gypsum Brd (R-0.5)	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0	0.080	
E R-11 R-11 R-13 R-13	½" Extr Poly Brd (R-2.5) ¾" Bead Brd (R-2.7) ½" Asphalt Brd (R-1.3) ¾" Bead Brd (R-1.8)	2.3	2.6	3.0	3.4	3.8	4.1	4.5	4.9	5.3	5.6	6.0	6.4	6.8	7.1	7.5	0.075	
F R-11 R-11 R-13 R-13	1" Bead Brd (R-3.6) ¾" Extr Poly Brd (R-3.8) ½" Extr Poly Brd (R-2.5) ¾" Bead Brd (R-2.7)	2.1	2.4	2.8	3.2	3.5	3.8	4.2	4.6	4.9	5.3	5.6	5.9	6.3	6.6	7.0	0.070	
G R-13 R-13	¾" Extr Poly Brd (R-3.8) 1" Bead Brd (R-3.6)	2.0	2.3	2.6	2.9	3.3	3.6	3.9	4.2	4.6	4.9	5.2	5.5	5.9	6.2	6.5	0.065	
H R-11 R-13 R-19	1" Extr Poly Brd (R-5.0) 1" Extr Poly Brd (R-5.0) ½" Gypsum Brd (R-0.5)	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6.0	0.060	
I. R-19 R-19	½" Asphalt Brd (R-1.3) ½" Bead Brd (R-1.8)	1.6	1.9	2.2	2.5	2.8	3.0	3.3	3.6	3.8	4.1	4.4	4.7	4.9	5.2	5.5	0.055	
J R-11 R-13 R-19 R-19	R-8 Sheathing R-8 Sheathing ½" or ¾" Extr Poly Brd ¾" or 1" Bead Brd	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.2	3.5	3.7	4.0	4.2	4.5	4.7	5.0	0.050	
K R-19	1" Extr Poly Brd (R-5.0)	1.3	1.6	1.8	2.0	2.2	2.5	2.7	2.9	3.1	3.4	3.6	3.8	4.0	4.3	4.5	0.045	
L R-19	R-8 Sheathing	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	0.040	

1. What is the Heat Multiplier Factor (HTM) for the following wood frame exterior walls with:

   a) No cavity insulation and gypsum board at 50°F temperature difference.

   b) Cavity insulation of R-13 and 3/4" extruded polystyrene board at 35°F temperature difference.

   c) Cavity insulation of R-19 and 1/2" asphalt board at 60°F temperature difference.

2. Using the temperature-pressure chart find the following:

   a) Pressure of R12 @ 0°F.

   b) Pressure of R22 @ -35°F.

   c) Temperature of R500 @ 16.4 PSIG.

   d) Temperature of R502 @ 12.3 inches of Mercury Vacuum.

Temperature-Pressure Chart

Vacuum—*Italic Figures* Gauge Pressure—**Bold Figures**

TEMPERATURE		REFRIGERANT				
	CCl_3F	CCl_2F_2	$CHClF_2$	(Azeotropic Mixtures)		NH_3
°F.	11	12	22	500	502	717
-60	-	*19.0*	*11.9*	-	*7.0*	*18.6*
-55	-	*17.3*	*9.1*	-	*3.6*	*16.6*
-50	-	*15.4*	*6.0*	-	0.0	*14.3*
-45	-	*13.3*	*2.6*	-	2.1	*11.7*
-40	*28.4*	*10.9*	0.6	*7.9*	4.3	*8.7*
-35	*28.1*	*8.3*	2.7	*4.8*	6.7	*5.4*
-30	*27.8*	*5.4*	5.0	*1.4*	9.4	*1.6*
-25	*27.3*	*2.3*	7.5	1.1	12.3	1.3
-20	*27.0*	0.5	10.3	3.1	15.5	3.6
-18	*26.9*	1.3	11.5	4.0	16.9	4.6
-16	*26.7*	2.0	12.7	4.9	18.3	5.6
-12	*26.2*	3.6	15.2	6.8	21.2	7.9
-10	*26.0*	4.4	16.6	7.8	22.8	9.0
- 8	*25.8*	5.3	18.0	8.8	24.4	10.3
- 6	*25.5*	6.2	19.4	9.9	26.0	11.6
- 4	*25.3*	7.1	20.9	11.0	27.7	12.9
- 2	*25.0*	8.1	22.5	12.1	29.4	14.3
0	*24.7*	9.2	24.1	13.3	31.2	15.7
1	*24.6*	9.7	24.9	13.9	32.2	16.5
2	*24.4*	10.2	25.7	14.5	33.1	17.2
3	*24.2*	10.7	26.6	15.1	34.1	18.0
4	*24.1*	11.2	27.4	15.7	35.0	18.8
5	*24.0*	11.8	28.3	16.4	36.0	19.6
6	*23.8*	12.3	29.2	17.0	37.0	20.4
7	*23.6*	12.9	30.1	17.7	38.0	21.2
8	*23.5*	13.5	31.0	18.4	39.0	22.1
9	*23.3*	14.0	32.0	19.0	40.0	22.9
10	*23.1*	14.6	32.9	19.7	41.1	23.8

Table 6-26

Dimensions of Type "L" Copper Tubing

TYPE	DIAMETERS		WALL THICKNESS INCHES	WEIGHT PER FOOT LBS.	TRANSVERSE AREA OF BORE		SURFACE AREA PER FOOT OF LENGTH	
	OUTSIDE INCHES	INSIDE INCHES			SQ. IN	SQ. FT.	EXTERNAL SQ. FT.	INTERNAL SQ. FT
L	1/2	0.430	0.035	0.1982	0.1452	0.001008	0.1309	0.1126
	5/8	0.545	0.040	0.2849	0.2333	0.001620	0.1636	0.1427
	3/4	0.666	0.042	0.3621	0.3484	0.002419	0.1963	0.1744
	7/8	0.785	0.045	0.4548	0.4840	0.003361	0.2291	0.2055
	1-1/8	1.025	0.050	0.6545	0.8252	0.005730	0.2945	0.2863
	1-3/8	1.265	0.055	0.8840	1.257	0.008728	0.3600	0.3312
	1-5/8	1.505	0.060	1.143	1.779	0.01235	0.4254	0.3940
	2-1/8	1.985	0.070	1.752	3.095	0.02149	0.5563	0.5197
	2-5/8	2.465	0.080	2.479	4.772	0.03314	0.6872	0.6453
	3-1/8	2.945	0.090	3.326	6.812	0.04730	0.8181	0.7710
	3-5/8	3.425	0.100	4.292	9.213	0.06398	0.9490	0.8967
	4-1/8	3.905	0.110	5.38	12.0	0.0833	1.08	1.02
	5-1/8	4.875	0.125	7.61	18.7	0.1300	1.34	1.28
	6-1/8	5.845	0.140	10.20	26.8	0.1862	1.60	1.53

3. For Type "L" copper tubing find the following:

   a) Wall thickness of 3/4" OD.

   b) Inside diameter of 1 1/8" OD.

   c) Weight per foot of 1/2" OD.

   d) Internal surface area per foot of length of 2 1/8" OD.

4. Using trigonometric functions tables (such as the one attached) complete the following:

   a) sin 42° 40'

   b) cos 63° 20'

   c) sin 21° 10'

NATURAL FUNCTIONS

TAN	0'	10'	20'	30'	40'	50'	60'	
0	.0000	.0029	.0058	.0087	.0116	.0145	.0175	89
1	.0175	.0204	.0233	.0262	.0291	.0320	.0349	88
2	.0349	.0378	.0407	.0437	.0466	.0495	.0524	87
3	.0524	.0553	.0582	.0612	.0641	.0670	.0699	86
4	.0699	.0729	.0758	.0787	.0816	.0846	.0875	85
5	.0875	.0904	.0934	.0963	.0992	.1022	.1051	84
	0'	10'	20'	30'	40'	50'	60'	
6	.1051	.1080	.1110	.1139	.1169	.1198	.1228	83
7	.1228	.1257	.1287	.1317	.1346	.1376	.1405	82
8	.1405	.1435	.1465	.1495	.1524	.1554	.1584	81
9	.1584	.1614	.1644	.1673	.1703	.1733	.1763	80
10	.1763	.1793	.1823	.1853	.1883	.1914	.1944	79
	0'	10'	20'	30'	40'	50'	60'	
11	.1944	.1974	.2004	.2035	.2065	.2095	.2126	78
12	.2126	.2156	.2186	.2217	.2247	.2278	.2309	77
13	.2309	.2339	.2370	.2401	.2432	.2462	.2493	76
14	.2493	.2524	.2555	.2586	.2617	.2648	.2679	75
15	.2679	.2711	.2742	.2773	.2805	.2836	.2867	74
	0'	10'	20'	30'	40'	50'	60'	
16	.2867	.2899	.2931	.2962	.2994	.3026	.3057	73
17	.3057	.3089	.3121	.3153	.3185	.3217	.3249	72
18	.3249	.3281	.3314	.3346	.3378	.3411	.3443	71
19	.3443	.3476	.3508	.3541	.3574	.3607	.3640	70
20	.3640	.3673	.3706	.3739	.3772	.3805	.3839	69
	0'	10'	20'	30'	40'	50'	60'	
21	.3839	.3872	.3906	.3939	.3973	.4006	.4040	68
22	.4040	.4074	.4108	.4142	.4176	.4210	.4245	67
23	.4245	.4279	.4314	.4348	.4383	.4417	.4452	66
24	.4452	.4487	.4522	.4557	.4592	.4628	.4663	65
25	.4663	.4699	.4734	.4770	.4806	.4841	.4877	64
	0'	10'	20'	30'	40'	50'	60'	
26	.4877	.4913	.4950	.4986	.5022	.5059	.5095	63
27	.5095	.5132	.5169	.5206	.5243	.5280	.5317	62
28	.5317	.5354	.5392	.5430	.5467	.5505	.5543	61
29	.5543	.5581	.5619	.5658	.5696	.5735	.5774	60
30	.5774	.5812	.5851	.5890	.5930	.5969	.6009	59
	0'	10'	20'	30'	40'	50'	60'	
31	.6009	.6048	.6088	.6128	.6168	.6208	.6249	58
32	.6249	.6289	.6330	.6371	.6412	.6453	.6494	57
33	.6494	.6536	.6577	.6619	.6661	.6703	.6745	56
34	.6745	.6787	.6830	.6873	.6916	.6959	.7002	55
35	.7002	.7046	.7089	.7133	.7177	.7221	.7265	54
	0'	10'	20'	30'	40'	50'	60'	
36	.7265	.7310	.7355	.7400	.7445	.7490	.7536	53
37	.7536	.7581	.7627	.7673	.7720	.7766	.7813	52
38	.7813	.7860	.7907	.7954	.8002	.8050	.8098	51
39	.8098	.8146	.8195	.8243	.8292	.8342	.8391	50
40	.8391	.8441	.8491	.8541	.8591	.8642	.8693	49
	0'	10'	20'	30'	40'	50'	60'	
41	.8693	.8744	.8796	.8847	.8899	.8952	.9004	48
42	.9004	.9057	.9110	.9163	.9217	.9271	.9325	47
43	.9325	.9380	.9435	.9490	.9545	.9601	.9657	46
44	.9657	.9713	.9770	.9827	.9884	.9942	1.000	45
45	1.000	1.006	1.012	1.018	1.024	1.030		44
	60'	50'	40'	30'	20'	10'	0'	COT

TAN	0'	10'	20'	30'	40'	50'	60'	
46	1.036	1.042	1.048	1.054	1.060	1.066	1.072	43
47	1.072	1.079	1.085	1.091	1.098	1.104	1.111	42
48	1.111	1.117	1.124	1.130	1.137	1.144	1.150	41
49	1.150	1.157	1.164	1.171	1.178	1.185	1.192	40
50	1.192	1.199	1.206	1.213	1.220	1.228	1.235	39
	0'	10'	20'	30'	40'	50'	60'	
51	1.235	1.242	1.250	1.257	1.265	1.272	1.280	38
52	1.280	1.288	1.295	1.303	1.311	1.319	1.327	37
53	1.327	1.335	1.343	1.351	1.360	1.368	1.376	36
54	1.376	1.385	1.393	1.402	1.411	1.419	1.428	35
55	1.428	1.437	1.446	1.455	1.464	1.473	1.483	34
	0'	10'	20'	30'	40'	50'	60'	
56	1.483	1.492	1.501	1.511	1.520	1.530	1.540	33
57	1.540	1.550	1.560	1.570	1.580	1.590	1.600	32
58	1.600	1.611	1.621	1.632	1.643	1.653	1.664	31
59	1.664	1.675	1.686	1.698	1.709	1.720	1.732	30
60	1.732	1.744	1.756	1.767	1.780	1.792	1.804	29
	0'	10'	20'	30'	40'	50'	60'	
61	1.804	1.816	1.829	1.842	1.855	1.868	1.881	28
62	1.881	1.894	1.907	1.921	1.935	1.949	1.963	27
63	1.963	1.977	1.991	2.006	2.020	2.035	2.050	26
64	2.050	2.066	2.081	2.097	2.112	2.128	2.145	25
65	2.145	2.161	2.177	2.194	2.211	2.229	2.246	24
	0'	10'	20'	30'	40'	50'	60'	
66	2.246	2.264	2.282	2.300	2.318	2.337	2.356	23
67	2.356	2.375	2.394	2.414	2.434	2.455	2.475	22
68	2.475	2.496	2.517	2.539	2.560	2.583	2.605	21
69	2.605	2.628	2.651	2.675	2.699	2.723	2.748	20
70	2.748	2.773	2.798	2.824	2.850	2.877	2.904	19
	0'	10'	20'	30'	40'	50'	60'	
71	2.904	2.932	2.960	2.989	3.018	3.047	3.078	18
72	3.078	3.108	3.140	3.172	3.204	3.237	3.271	17
73	3.271	3.305	3.340	3.376	3.412	3.450	3.487	16
74	3.487	3.526	3.566	3.606	3.647	3.689	3.732	15
75	3.732	3.776	3.821	3.867	3.914	3.962	4.011	14
	0'	10'	20'	30'	40'	50'	60'	
76	4.011	4.061	4.113	4.165	4.219	4.275	4.332	13
77	4.332	4.390	4.449	4.511	4.574	4.638	4.705	12
78	4.705	4.773	4.843	4.915	4.989	5.066	5.145	11
79	5.145	5.226	5.309	5.396	5.485	5.576	5.671	10
80	5.671	5.769	5.871	5.976	6.084	6.197	6.314	9
	0'	10'	20'	30'	40'	50'	60'	
81	6.314	6.435	6.561	6.691	6.827	6.968	7.115	8
82	7.115	7.269	7.429	7.596	7.770	7.953	8.144	7
83	8.144	8.345	8.556	8.777	9.010	9.255	9.514	6
84	9.514	9.788	10.08	10.39	10.71	11.06	11.43	5
85	11.43	11.83	12.25	12.71	13.20	13.73	14.30	4
	0'	10'	20'	30'	40'	50'	60'	
86	14.30	14.92	15.60	16.35	17.17	18.07	19.08	3
87	19.08	20.21	21.47	22.90	24.54	26.43	28.64	2
88	28.64	31.24	34.37	38.19	42.96	49.10	57.29	1
89	57.29	68.75	85.94	114.6	171.9	343.8		0
90								
	60'	50'	40'	30'	20'	10'	0'	COT

MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

Minutes	Degrees	Minutes	Degrees
1	.02	16	.27
2	.03	17	.28
3	.05	18	.30
4	.07	19	.32
5	.08	20	.33
6	.10	21	.35
7	.12	22	.36
8	.13	23	.38
9	.15	24	.40
10	.17	25	.42
11	.18	26	.43
12	.20	27	.45
13	.21	28	.46
14	.23	29	.48
15	.25	30	.50
Minutes	Degrees	Minutes	Degrees

MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

Minutes	Degrees	Minutes	Degrees
31	.52	46	.77
32	.53	47	.78
33	.55	48	.80
34	.57	49	.82
35	.58	50	.83
36	.60	51	.85
37	.62	52	.87
38	.63	53	.88
39	.65	54	.90
40	.67	55	.92
41	.68	56	.93
42	.70	57	.95
43	.72	58	.97
44	.73	59	.98
45	.75	60	1.00
Minutes	Degrees	Minutes	Degrees

BEST COPY AVAILABLE

NATURAL FUNCTIONS

SIN	0'	10	20	30	40	50	60	
0	.0000	.0029	.0058	.0087	.0116	.0145	.0175	89
1	.0175	.0204	.0233	.0262	.0291	.0320	.0349	88
2	.0349	.0378	.0407	.0436	.0465	.0494	.0523	87
3	.0523	.0552	.0581	.0610	.0640	.0669	.0698	86
4	.0698	.0727	.0756	.0785	.0814	.0843	.0872	85
5	.0872	.0901	.0929	.0958	.0987	.1016	.1045	84
	0	10	20	30	40	50	60	
6	.1045	.1074	.1103	.1132	.1161	.1190	.1219	83
7	.1219	.1248	.1276	.1305	.1334	.1363	.1392	82
8	.1392	.1421	.1449	.1478	.1507	.1536	.1564	81
9	.1564	.1593	.1622	.1650	.1679	.1708	.1736	80
10	.1736	.1765	.1794	.1822	.1851	.1880	.1908	79
	0	10	20	30	40	50	60	
11	.1908	.1937	.1965	.1994	.2022	.2051	.2079	78
12	.2079	.2108	.2136	.2164	.2193	.2221	.2250	77
13	.2250	.2278	.2306	.2334	.2363	.2331	.2419	76
14	.2419	.2447	.2476	.2504	.2532	.2560	.2588	75
15	.2588	.2616	.2644	.2672	.2700	.2728	.2756	74
	0	10	20	30	40	50	60	
16	.2756	.2784	.2812	.2840	.2868	.2896	.2924	73
17	.2924	.2952	.2979	.3007	.3035	.3062	.3090	72
18	.3090	.3118	.3145	.3173	.3201	.3228	.3256	71
19	.3256	.3283	.3311	.3338	.3365	.3393	.3420	70
20	.3420	.3448	.3475	.3502	.3529	.3557	.3584	69
	0	10	20	30	40	50	60	
21	.3584	.3611	.3638	.3665	.3692	.3719	.3746	68
22	.3746	.3773	.3800	.3827	.3854	.3881	.3907	67
23	.3907	.3934	.3961	.3987	.4014	.4041	.4067	66
24	.4067	.4094	.4120	.4147	.4173	.4200	.4226	65
25	.4226	.4253	.4279	.4305	.4331	.4358	.4384	64
	0	10	20	30	40	50	60	
26	.4384	.4410	.4436	.4462	.4488	.4514	.4540	63
27	.4540	.4566	.4592	.4617	.4643	.4669	.4695	62
28	.4695	.4720	.4746	.4772	.4797	.4823	.4848	61
29	.4848	.4874	.4899	.4924	.4950	.4975	.5000	60
30	.5000	.5025	.5050	.5075	.5100	.5125	.5150	59
	0'	10	20'	30	40	50	60	
31	.5150	.5175	.5200	.5225	.5250	.5275	.5299	58
32	.5299	.5324	.5348	.5373	.5398	.5422	.5446	57
33	.5446	.5471	.5495	.5519	.5544	.5568	.5592	56
34	.5592	.5616	.5640	.5664	.5688	.5712	.5736	55
35	.5736	.5760	.5783	.5807	.5831	.5854	.5878	54
	0'	10	20'	30	40	50	60	
36	.5878	.5901	.5925	.5948	.5972	.5995	.6018	53
37	.6018	.6041	.6065	.6088	.6111	.6134	.6157	52
38	.6157	.6180	.6202	.6225	.6248	.6271	.6293	51
39	.6293	.6316	.6338	.6361	.6383	.6406	.6428	50
40	.6428	.6450	.6472	.6494	.6517	.6539	.6561	49
	0	10'	20	30	40	50'	60	
41	.6561	.6583	.6604	.6626	.6648	.6670	.6691	48
42	.6691	.6713	.6734	.6756	.6777	.6799	.6820	47
43	.6820	.6841	.6862	.6884	.6905	.6926	.6917	46
44	.6947	.6967	.6988	.7009	.7030	.7050	.7071	45
45	.7071	.7092	.7112	.7133	.7153	.7173	.7193	44
	60	50'	40	30'	20	10	0	COS

SIN	0'	10'	20'	30'	40'	50'	60	
46	.7193	.7214	.7234	.7254	.7274	.7294	.7314	43
47	.7314	.7333	.7353	.7373	.7392	.7412	.7431	42
48	.7431	.7451	.7470	.7490	.7509	.7528	.7547	41
49	.7547	.7566	.7585	.7604	.7623	.7642	.7660	40
50	.7660	.7679	.7698	.7716	.7735	.7753	.7771	39
	0	10	20	30	40'	50	60	
51	.7771	.7790	.7808	.7826	.7844	.7862	.7880	38
52	.7880	.7898	.7916	.7934	.7951	.7969	.7986	37
53	.7986	.8004	.8021	.8039	.8056	.8073	.8090	36
54	.8090	.8107	.8124	.8141	.8158	.8175	.8192	35
55	.8192	.8208	.8225	.8241	.8258	.8274	.8290	34
	0'	10	20'	30	40'	50'	60	
56	.8290	.8307	.8323	.8339	.8355	.8371	.8387	33
57	.8387	.8403	.8418	.8434	.8450	.8465	.8480	32
58	.8480	.8496	.8511	.8526	.8542	.8557	.8572	31
59	.8572	.8587	.8601	.8616	.8631	.8646	.8660	30
60	.8660	.8675	.8689	.8704	.8718	.8732	.8746	29
	0'	10'	20	30	40	50'	60	
61	.8746	.8760	.8774	.8788	.8802	.8816	.8829	28
62	.8829	.8843	.8857	.8870	.8884	.8897	.8910	27
63	.8910	.8923	.8936	.8949	.8962	.8975	.8988	26
64	.8988	.9001	.9013	.9026	.9038	.9051	.9063	25
65	.9063	.9075	.9088	.9100	.9112	.9124	.9135	24
	0'	10	20	30'	40	50'	60	
66	.9135	.9147	.9159	.9171	.9182	.9194	.9205	23
67	.9205	.9216	.9228	.9239	.9250	.9261	.9272	22
68	.9272	.9283	.9293	.9304	.9315	.9325	.9336	21
69	.9336	.9346	.9356	.9367	.9377	.9387	.9397	20
70	.9397	.9407	.9417	.9426	.9436	.9446	.9455	19
	0	10	20	30	40	50	60	
71	.9455	.9465	.9474	.9483	.9492	.9502	.9511	18
72	.9511	.9520	.9528	.9537	.9546	.9555	.9563	17
73	.9563	.9572	.9580	.9588	.9596	.9605	.9613	16
74	.9613	.9621	.9628	.9636	.9644	.9652	.9659	15
75	.9659	.9667	.9674	.9681	.9689	.9698	.9703	14
	0	10	20'	30'	40'	50	60	
76	.9703	.9710	.9717	.9724	.9730	.9737	.9744	13
77	.9744	.9750	.9757	.9763	.9769	.9775	.9781	12
78	.9781	.9787	.9793	.9799	.9805	.9811	.9816	11
79	.9816	.9822	.9827	.9833	.9838	.9843	.9848	10
80	.9848	.9853	.9858	.9863	.9868	.9872	.9877	9
	0'	10'	20'	30'	40'	50'	60	
81	.9877	.9881	.9886	.9890	.9894	.9899	.9903	8
82	.9903	.9907	.9911	.9914	.9918	.9922	.9925	7
83	.9925	.9929	.9932	.9936	.9939	.9942	.9945	6
84	.9945	.9948	.9951	.9954	.9957	.9959	.9962	5
85	.9962	.9964	.9967	.9969	.9971	.9974	.9976	4
	0'	10'	20'	30'	40'	50'	60	
86	.9976	.9978	.9980	.9981	.9983	.9985	.9986	3
87	.9986	.9988	.9989	.9990	.9992	.9993	.9994	2
88	.9994	.9995	.9996	.9997	.9997	.9998	.9998	1
89	.9998	.9999	.9999	1.000	1.000	1.000	1.000	0
90	1.000							
	60'	50'	40'	30'	20'	10'	0'	COS

MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

Minutes	Degrees	Minutes	Degrees
1	.02	16	.27
2	.03	17	.28
3	.05	18	.30
4	.07	19	.32
5	.08	20	.33
6	.10	21	.35
7	.12	22	.36
8	.13	23	.38
9	.15	24	.40
10	.17	25	.42
11	.18	26	.43
12	.20	27	.45
13	.21	28	.46
14	.23	29	.48
15	.25	30	.50
Minutes	Degrees	Minutes	Degrees

MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

Minutes	Degrees	Minutes	Degrees
31	.52	46	.77
32	.53	47	.78
33	.55	48	.80
34	.57	49	.82
35	.58	50	.83
36	.60	51	.85
37	.62	52	.87
38	.63	53	.88
39	.65	54	.90
40	.67	55	.92
41	.68	56	.93
42	.70	57	.95
43	.72	58	.97
44	.73	59	.98
45	.75	60	1.00
Minutes	Degrees	Minutes	Degrees

5. TABLE OF LAP AND WASTE ALLOWANCES FOR LAP SIDING

WIDTH	EXPOSURE TO WEATHER	ADD FOR LAP AND WASTE
12"	10 1/2"	15%
12"	10"	20%
10"	8 1/2"	18%
10"	8"	24%
8"	6 1/2"	23%
6"	5"	25%
6"	4 3/4"	32%
6"	4 1/2"	38%
4"	2 3/4"	51%
4"	2 1/2"	65%

a) How much more 4" siding will be needed for a 2 1/2" exposure than a 2 3/4" exposure?

b) How much is the lap and waste allowance for 12" lap siding with a 10" weather exposure?

c) What is the amount to add for lap and waste when 8" is exposed on 10" lap siding?

d) If a homeowner wishes to use 12" siding with 10 1/2" exposed, instead of using 10" siding with 8" exposed, how much less siding will it take to do the job?

e) What is the exposure of 12" siding if the waste and lap allowance is 15%?

f) The exposure of 2 3/4" for 4" siding has a waste and lap factor of 51%. What is the factor for 6" siding with an exposure of 4 3/4"?

COMPETENCY #41

Interpolate to find information missing from a table.

PERFORMANCE OBJECTIVE #57

Given a table, interpolate to find a value between two given values.

INSTRUCTIONAL ACTIVITIES

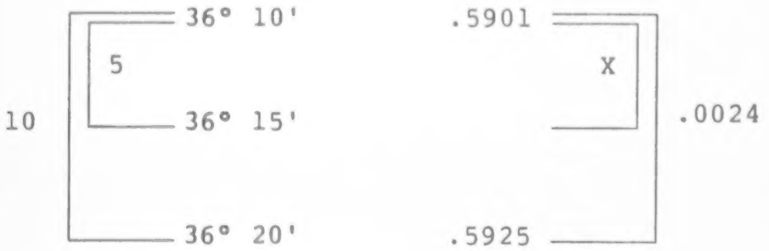
Sample Item

Find sin 36° 15', given the information below.

sin 36° 10'	.5901
sin 36° 20'	.5925

Solution:

a) Set up a table like the one below. Subtract to find the indicated differences.



b) Set up a proportion and solve for x.

$$\frac{5}{10} = \frac{x}{.0024}$$

$$10x = .0120$$
$$x = .0012$$

c) Add .0012 to .5901 since as the angle increases its sin increases.

$$\begin{array}{r} .5901 \\ +\ .0012 \\ \hline .5913 \end{array}$$

d) Sin 36° 15' is .5913.

Notes

Practice in interpolating data can enable a student to make better estimates when reading tables. This sheet provides problems using one method of interpolation.

REFERENCE TO TEXT

None

EVALUATION

Depth of Water in Feet	Water Pressure in PSI
4	1.73
8	3.46
12	5.19

1. What is the water pressure in PSI at :

   a) 5 feet
   b) 10 feet

2. How deep is the water when the pressure PSI is:

   a) 4
   b) 5

ANSWERS TO EVALUATION

1. a) 2.16 PSI

   b) 4.33 PSI

2. a) 9.25 ft.

   b) 11.56 ft.

ANSWERS TO APPLICATIONS

1. 2.595 PSI

2. .3057

3. a) 14.57"

   b) 14.59"

4. .9260

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #57

Performance Objective #57: Given a table, interpolate to find a value between two given values.

1. Using the information below, interpolate to find the water pressure in PSI at 6 ft.

Depth of Water in Feet	Water Pressure in PSI
4	1.73
8	3.46

2. Using the information below, find cos 72° 12'. (NOTE: As the size of the angle increases, its cosine decreases.)

cos 72° 10'	.3062
cos 72° 20'	.3035

3. In the rafter table below, the lengths of common rafters are shown for rises per foot of run. Interpolate to find the length of a common rafter per foot of run when the rise is:

a) 8 1/4"

b) 8.3"

Rise per Foot of Run	Length of Common Rafter
8"	14.42"
9"	15.00"

4. Using the information below, find tan 42° 48'.

tan 42° 40'	.9217
tan 42° 50'	.9271

COMPETENCY #42

Read and interpret line, bar and circle graphs.

PERFORMANCE OBJECTIVE #58

Given a line graph, answer questions pertaining to the information in the graph.

INSTRUCTIONAL ACTIVITIES

Notes

As graphs are studied, students should learn not only to read information directly but to use the information to make better decisions.

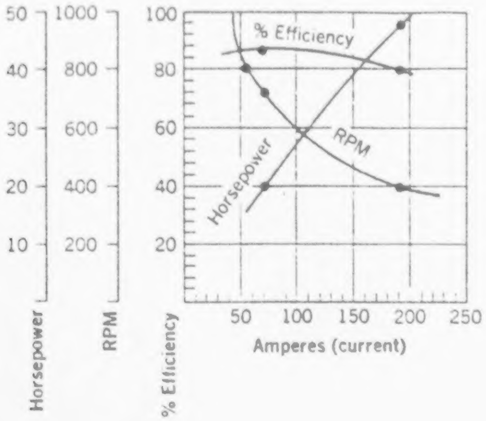
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 326-329, 332-333.

EVALUATION

1. At maximum efficiency, what is the:
   a) RPM?
   b) horsepower?

2. Find the current, efficiency, and horsepower for a speed of 600 rpm.



ANSWERS TO EVALUATION

1. a) 720 RPM
   b) 20 HP

2. Current = 100 amps; efficiency 88-90%; horsepower = 28

ANSWERS TO APPLICATIONS

1. a) 7.8 HP
   b) 80%
   c) 1.85 in W.C.

2. a) 22,000 BTUH
   b) 12,500 BTUH
   c) 11,000 BTUH
   d) 8,000 BTUH

3. a) 4,700 FPM
   b) 1,875 FPM
   c) 3,600 FPM
   d) 1,450 FPM
   e) 2,700 FPM

4. a) 800
   b) 750
   c) 725
   d) 775
   e) 5,325
   f) 50

5. a) Price of one-half inch 3-ply 4' x 8' plywood
   b) Cost in dollars
   c) 1988-89

6. a) $13,000
   b) $5,000
   c) September ($87,000)

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #58

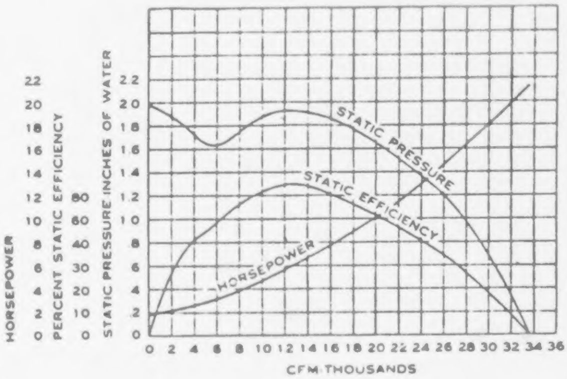
Performance Objective #58: Given a line graph, answer questions pertaining to the information in the graph.

1. An air conditioning fan with forward curved blades is running at a speed to move 16,000 cubic feet of air per minute. Find the following:

   a) Horsepower required

   b) % static efficiency

   c) Static pressure



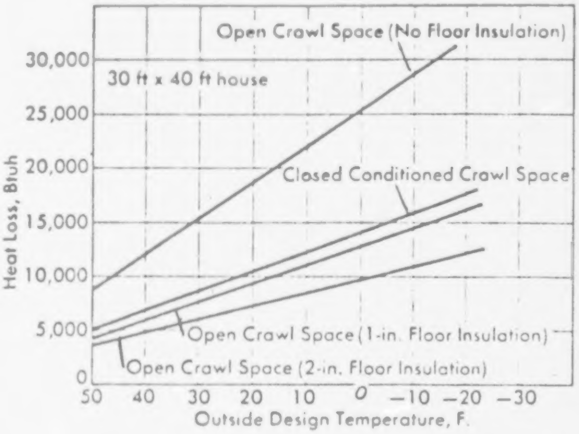
2. What will be the heat loss, in BTUH, with an outside design temperature of +10°F for the following conditions?

   a) Open crawl space with no floor insulation

   b) Closed conditioned crawl space

   c) Open crawl space with 1" floor insulation

   d) Open crawl space with 2" floor insulation



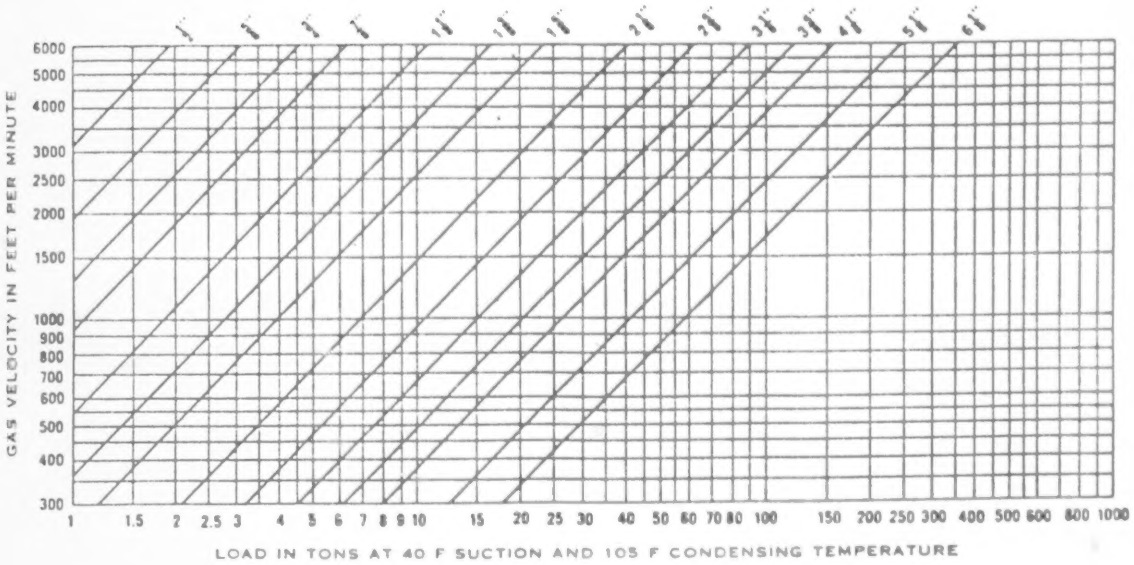
4-1 Comparison of below-floor heat losses for crawl-space structure.

3. Type "L" copper tubing is used to connect the compressor to the evaporator. The compressor is operating at 40°F suction temperature. What will be the suction gas velocity for the following load and tubing size combinations?

	Tons	Tubing Size (in)	Velocity (FPM)
a)	1.5	1/2	________________
b)	1.5	3/4	________________
c)	10	1 3/8	________________
d)	10	2 1/8	________________
e)	40	3 1/8	________________

Suction Gas Velocities for Refrigerant-12

OUTSIDE DIAMETER-TYPE L COPPER TUBING



4. Referring to the following graph, answer these questions. (NOTE: Answers should be correct to the nearest 25.)

   a) How many houses were constructed in 1976?

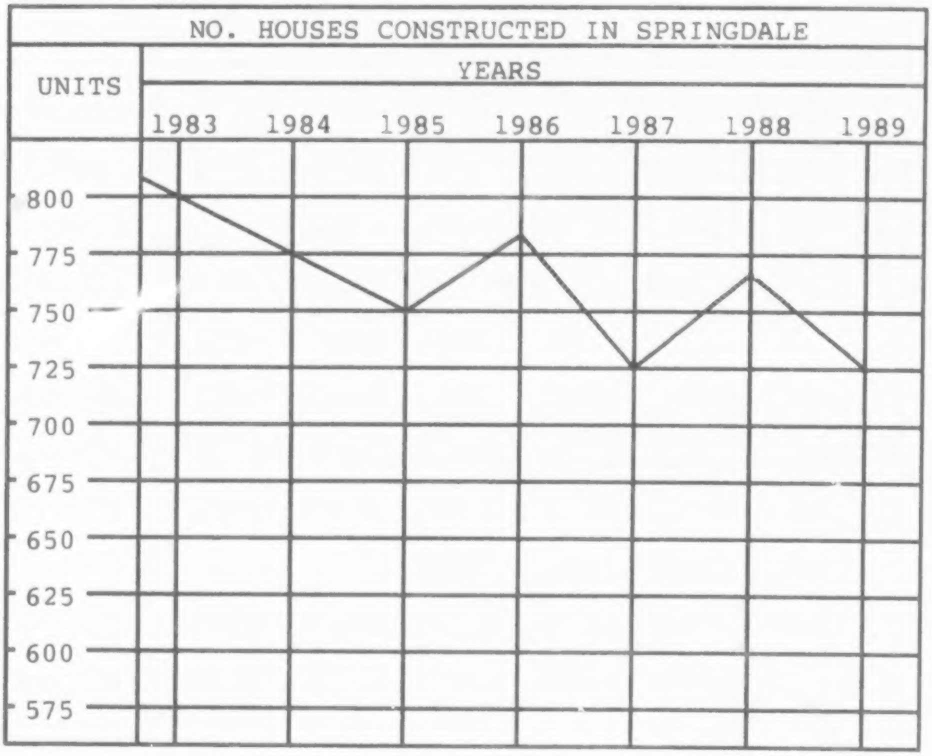
   b) In 1985?

   c) In 1989?

   d) In 1986?

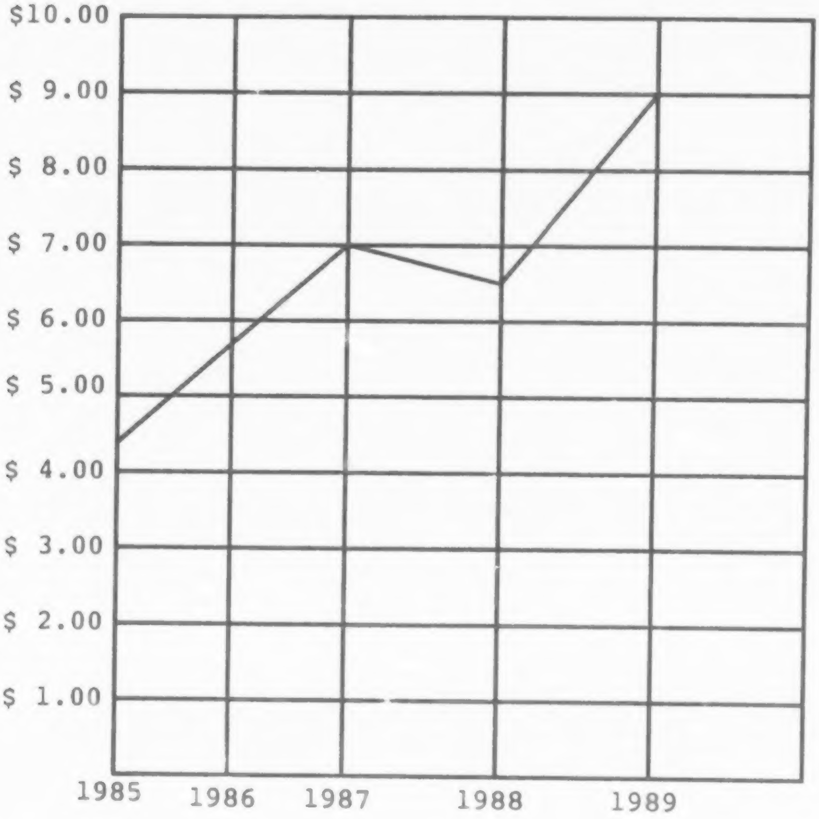
   e) From 1983 and 1989 inclusive?

   f) How many more houses were constructed in Springdale in 1988 than in 1987?



5. a) What is the title of the graph?
b) What do the vertical markings show?
c) In what period was the greatest increase in price?

PRICE OF ONE-HALF INCH 3 PLY 4' × 8' PLYWOOD

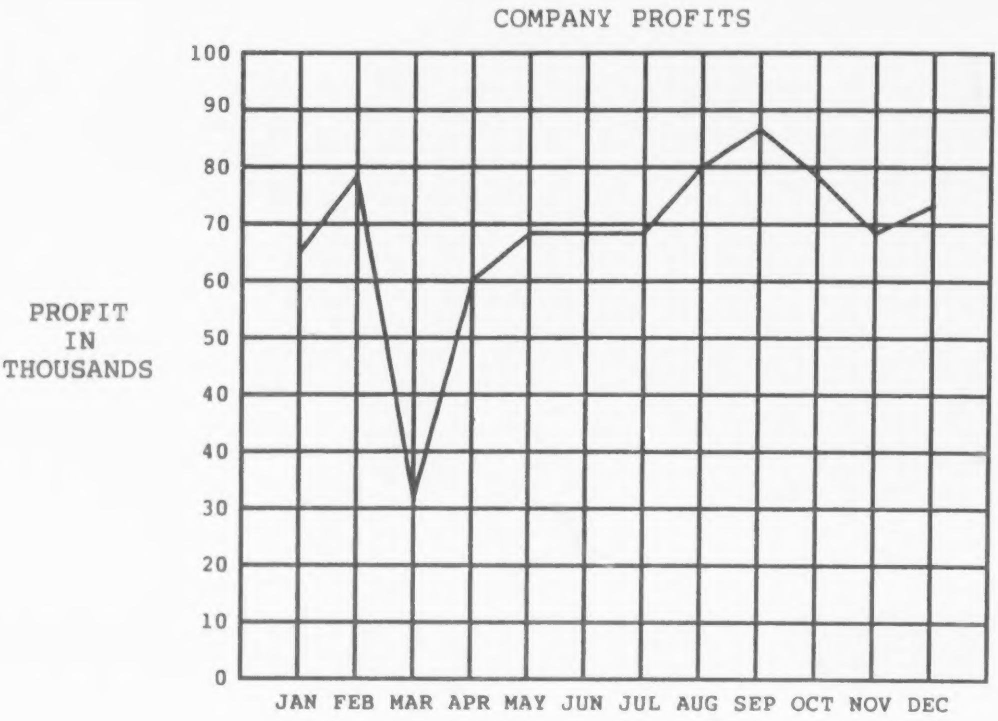


YEAR

6. a) What was the difference between January profits and February profits?

b) What was the difference between May profits and December profits?

c) What month had the biggest profit and how much?



COMPETENCY #42

Read and interpret line, bar and circle graphs.

PERFORMANCE OBJECTIVE #59

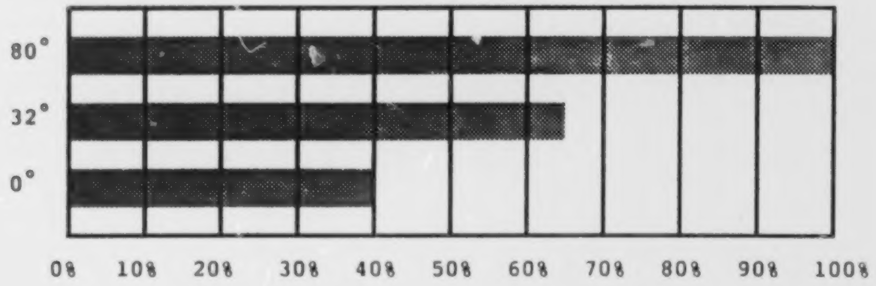
Given a bar graph, answer questions pertaining to the information in the graph.

INSTRUCTIONAL ACTIVITIES

Sample Item

What is the cranking power at freezing (32°F)? (ans: 65%)

CRANKING POWER OF BATTERY



PERCENT OF POWER

Notes

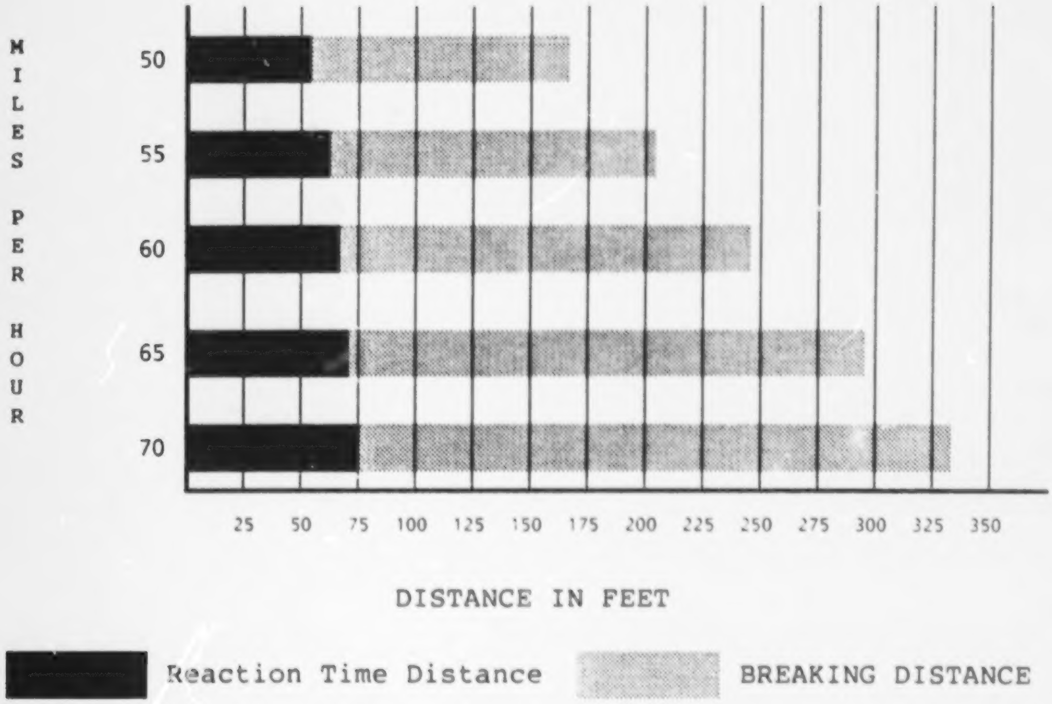
Students should be able to distinguish the kind of information given in a bar graph from the information in a line graph. The bar graph is easier to read than the line graph because each item of information is usually represented by a single bar. On line graphs, several items may be represented on a single line.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 322-325, 332-333.

EVALUATION

STOPPING DISTANCE



1. a) What is the total stopping distance at 55 MPH?

   b) Of this, what is the reaction distance?

   c) What is the actual braking distance?

2. At what speed is the total stopping distance at 290 feet?

3. What is the total stopping distance for 70 MPH?

ANSWERS TO EVALUATION

1. a) Approx. 210 ft.
   b) 62 ft.
   c) Approx. 148 ft.
2. 65 mph
3. 337 ft.

ANSWERS TO APPLICATIONS

1. a) 1986 to 1987
   b) 4 million
   c) 1987 - 88
2. a) 1978 to 1986; $290,000
   b) $80,000
   c) $35,000
3. Enrollment was 175 in 1986; in 1989 the enrollment was 250, an increase of 75.

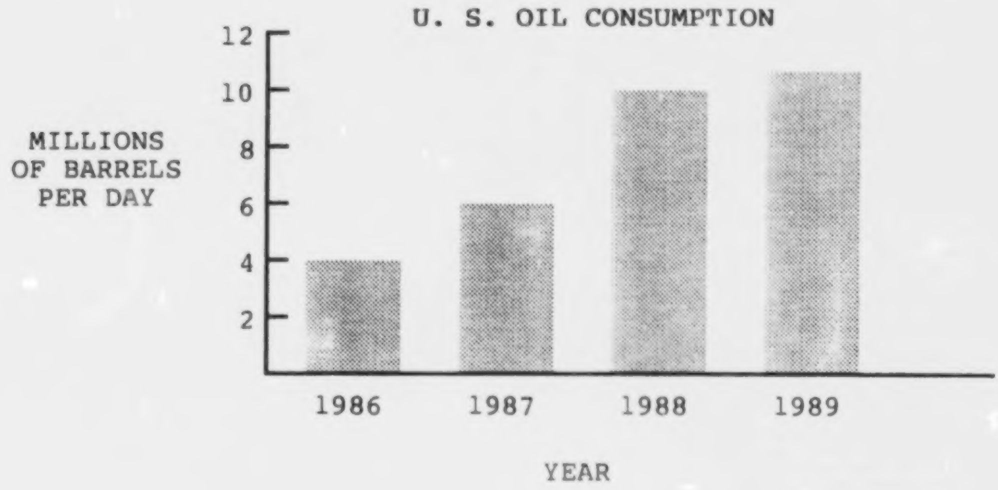
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #59

Performance Objective #59: Given a bar graph, answer questions pertaining to the information in the graph.

1. a) Between which years did consumption increase the most?

   b) By how much?

   c) Between which years did consumption increase the least?

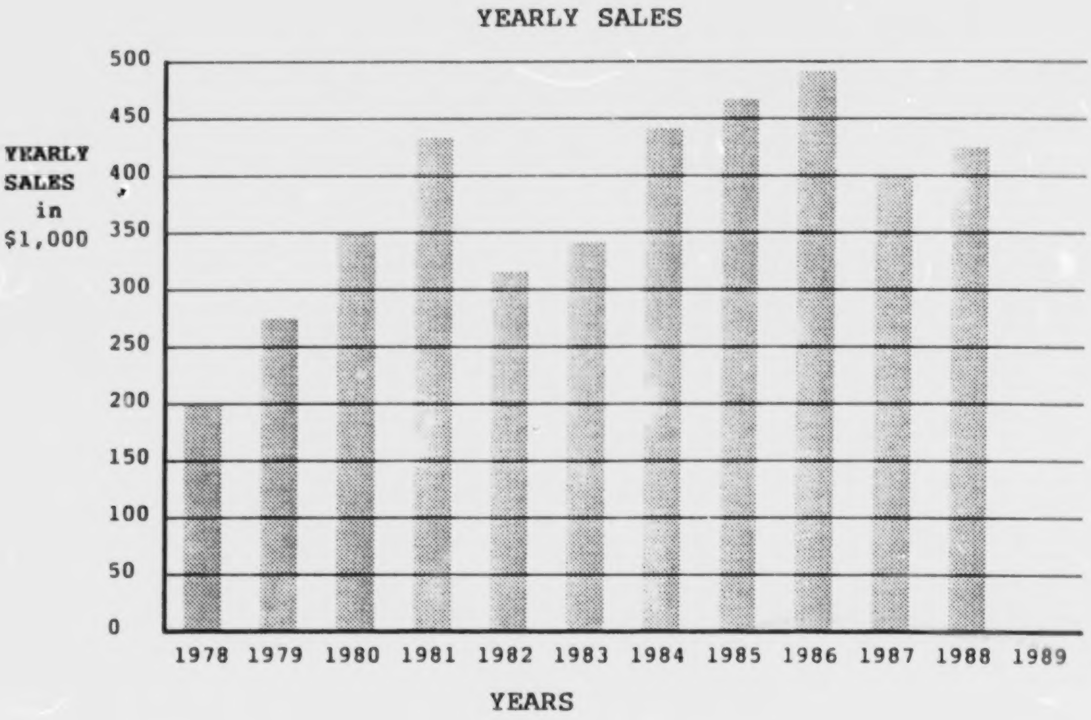


2. a) What was the difference in yearly sales in the highest and lowest years?

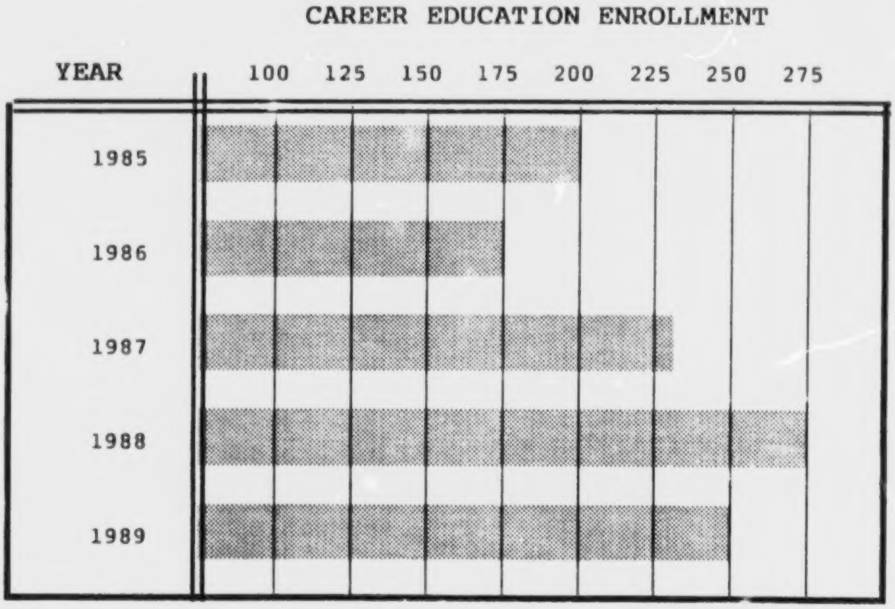
   b) What was the difference in 1978 sales and 1983 sales?

   c) What was the difference in sales from 1976 to 1982?

   (NOTE: Use the graph at the top of the following page.)



3. At Hampton High School, the career education enrollment during the past 5 years is shown on the bar graph. How many more students were enrolled in 1987 than in 1984?



COMPETENCY #42

Read and interpret line, bar and circle graphs.

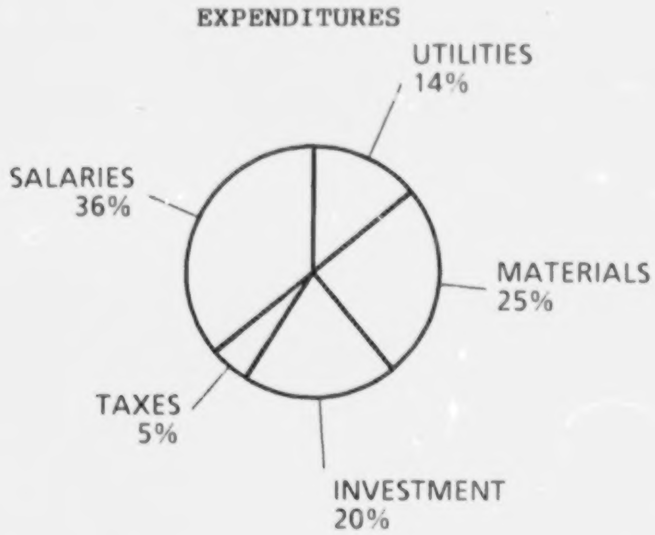
PERFORMANCE OBJECTIVE #60

Given a circle graph, answer questions pertaining to the information in the graph.

INSTRUCTIONAL ACTIVITIES

Sample Item

If a company had $80,000 in expenditures, how much did it spend on materials? (ans: $20,000)



Notes

The circle graph is used to show parts or percents of the whole (100%). The visual effect of the circle graph makes it easy to read and interpret.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 330-331.

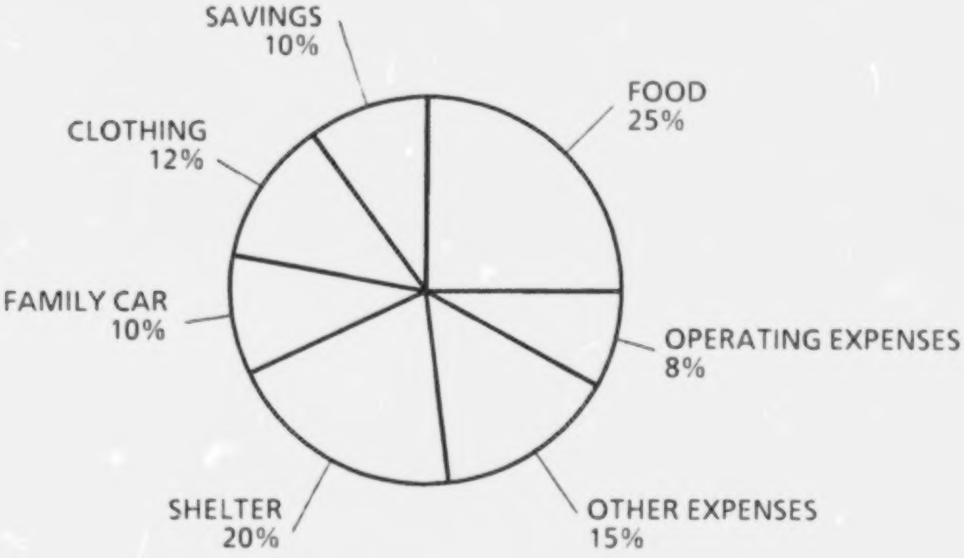
EVALUATION

Use the graph below to answer the following questions regarding the family budget.

a) What fractional part of its entire income does the Harris family plan to spend on food? for shelter?

b) Compare the percent to be spent for shelter to the percent of savings.

c) If the family income is $18,600 per year, what are the amounts to be spent for each item per year?



The Harris Family Budget

ANSWERS TO EVALUATION

1. a) Food 1/4, shelter 1/5
   b) 10% more for shelter
   c)

Savings	$1860
Food	$4650
Operating Expenses	$1488
Other Expenses	$2790
Shelter	$3720
Family Car	$1860
Clothing	$2232

ANSWERS TO APPLICATIONS

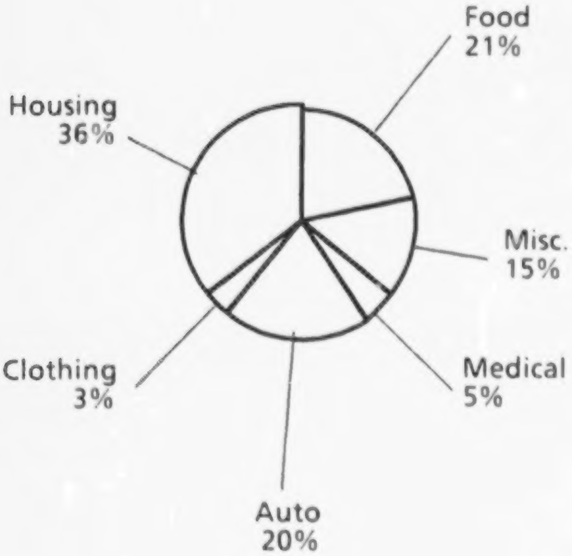
1. a) Materials
   b) 56%
   c) 32%

2. a) 40%
   b) 6%
   c) 28%

3. a) 15% more
   b) $86,000
   c) $344,000

   d) 54°

			Degrees	Amount
4.	a)	Food 21%	75°	$142.80
	b)	Clothing 3%	11°	20.40
	c)	Housing 36%	130°	244.80
	d)	Automobile 20%	72°	136.00
	e)	Medical 5%	18°	34.00
	f)	Misc. 15%	54°	102.00

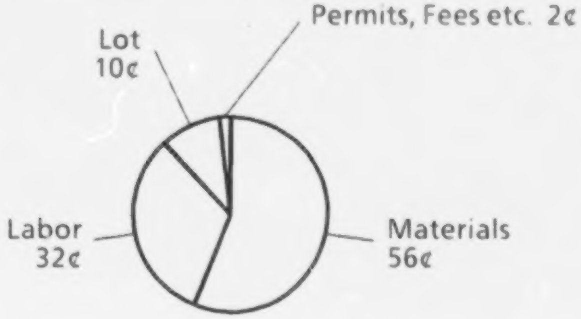


APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #60

Performance Objective #60: Given a circle graph, answer questions pertaining to the information in the graph.

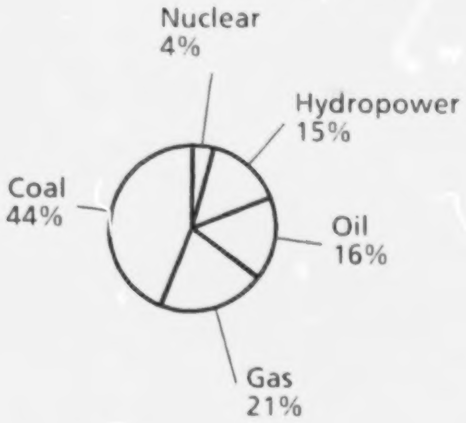
1. a) What presents the largest part of the cost of a new home?
   b) What percent of the total is this cost?
   c) What percent of the total cost is labor?

COST OF A NEW HOME

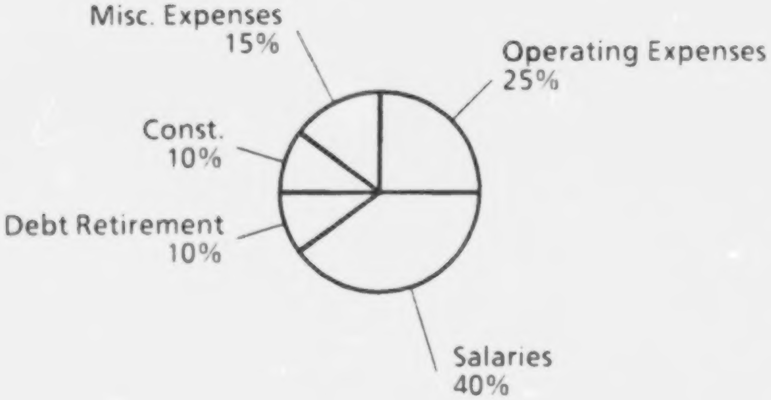


2. a) What is the difference between coal usage and nuclear usage?
   b) How much more gas was used than hydropower?
   c) How much more coal was used than oil?

ENERGY SOURCES



BUDGET FOR FISCAL YEAR '83
TOWN OF SALEM
TOTAL BUDGET: $860,000.00



3. Using the circle graph above, determine answers to the following questions:

   a) How much more (%) was spent for salaries than for operating expenses?
   b) How many dollars were spent for debt retirement?
   c) How many dollars were spent for salaries?
   d) How many degrees of arc are represented by 15% of the circle?

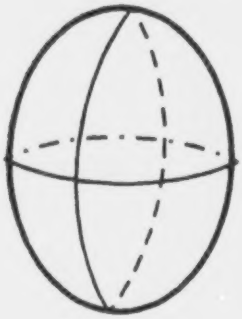
4. Construct a circle graph 4" in diameter. Draw radii from center of circle to create sectors accurate within 1 degree. The instructor will measure sectors with a protractor to check accuracy. Graphically represent the following information in the circle.

   Title: **Family Budget**
   Total amount: $680 monthly (100%)

   a) Food 21%
   b) Clothing 3%
   c) Housing 36%
   d) Automobile 20%
   e) Medical 5%
   f) Misc. 15%

section VII

geometry



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCIES #43 and 44

#43 Identify perpendicular lines.
#44 Identify parallel lines.

PERFORMANCE OBJECTIVE #61

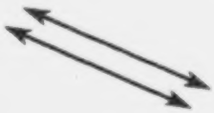
Given pairs of parallel and perpendicular lines, identify each.

INSTRUCTIONAL ACTIVITIES

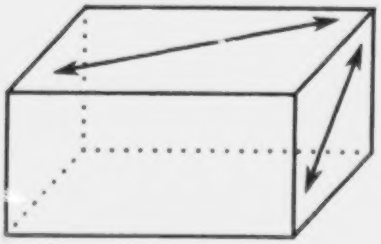
Sample Item

Identify each pair of lines as parallel, perpendicular or neither.

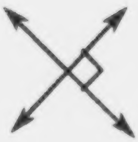
A.



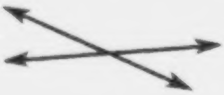
B.



C.



D.



ans: a) parallel
b) neither (lines are not in the same plane
c) perpendicular
d) neither (no right angle)

Notes

When two lines intersect and form one right angle, all four angles formed are right angles and the two lines are PERPENDICULAR. Two lines in the same plane that do not intersect are PARALLEL LINES.

Parallel and perpendicular lines are used in blue prints, drawings and all construction. These terms are also used in the installation of duct, pipe, and equipment.

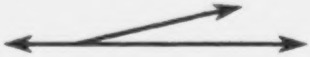
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 162-169.

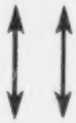
EVALUATION

Identify the following as parallel, perpendicular or neither.

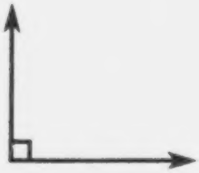
1.



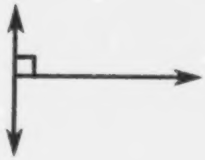
2.



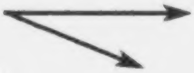
3.



4.



5.



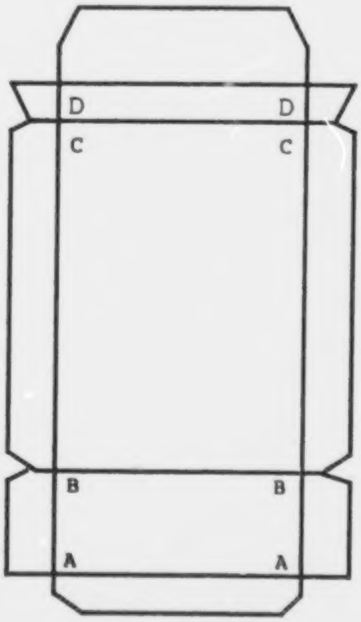
6. Replace the ? with parallel or perpendicular (∥ or ⊥).

a) BC ? BB

b) BC ? AD

c) AA ? BB

d) AA ? AB



ANSWERS TO EVALUATION

1. Neither
2. Parallel
3. Perpendicular
4. Perpendicular
5. Neither
6. a) $\perp$ c) $\parallel$
   b) $\parallel$ d) $\perp$

ANSWERS TO APPLICATIONS

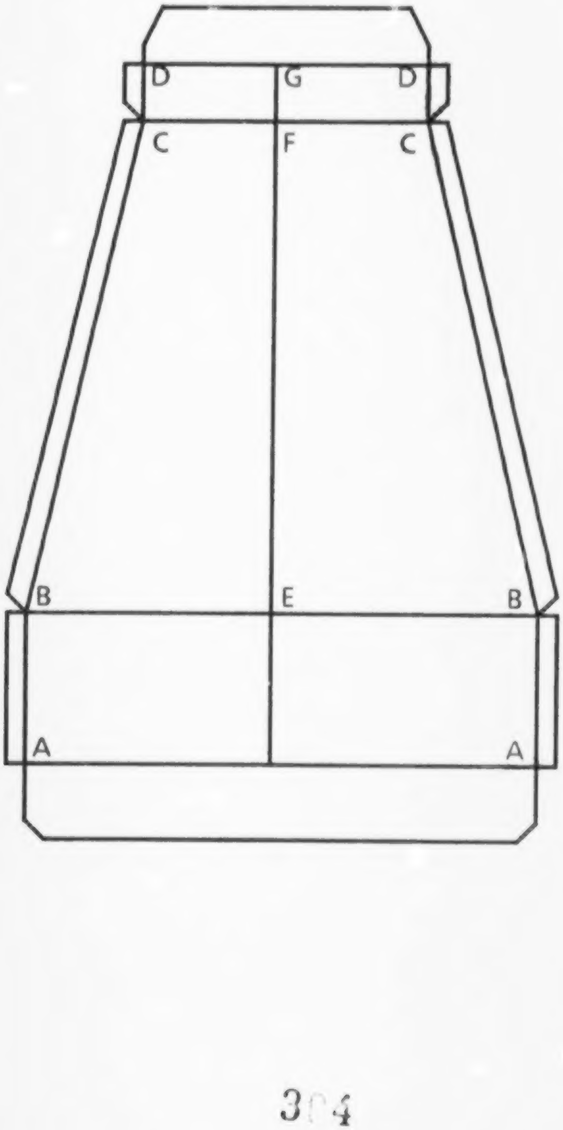
1. Parallel: DD, CC; CC, BB; BB, AA; AB, AB
   Perpendicular: BA, AA; AB, BB; FE, BB; EF, CC
2. Parallel: HG, AD; AB, DE; HC, FG
   Perpendicular: HC, BC; DE, EF; AB, AD; EF, AB; FG, HG
3. Parallel: Ef, AB; AE, BF; AA, BB
   Perpendicular: FE, EA; DC, AA; DC, BB; EF, BF; AB, BF
4. a) perpendicular
   b) neither
   c) parallel
5. AB $\parallel$ DC; AD $\parallel$ BC
6. AB $\parallel$ DC; AD $\parallel$ BC
7. AB, HG; EF, HG; CB, DE; AH, FG; CD, HG
8. Line M
9. Line EF
10. Line GH

APPLICATIONS FOR PERFORMANCE OBJECTIVE #61

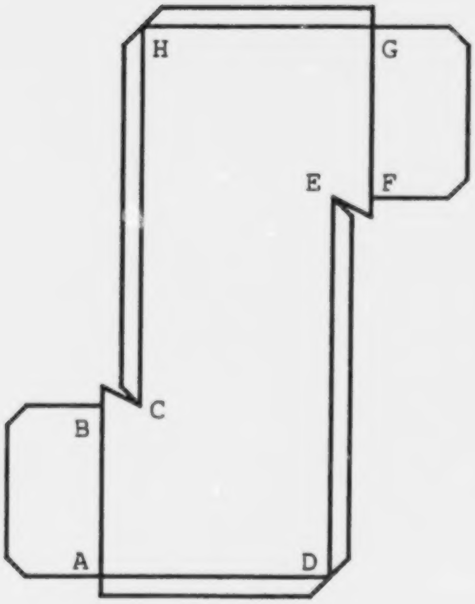
Performance Objective #61: Given parts of parallel and perpendicular lines, identify each.

On the three drawings which follow identify three pairs of lines that are parallel and three pairs of lines that are perpendicular. Example: Line CC is parallel to DD.

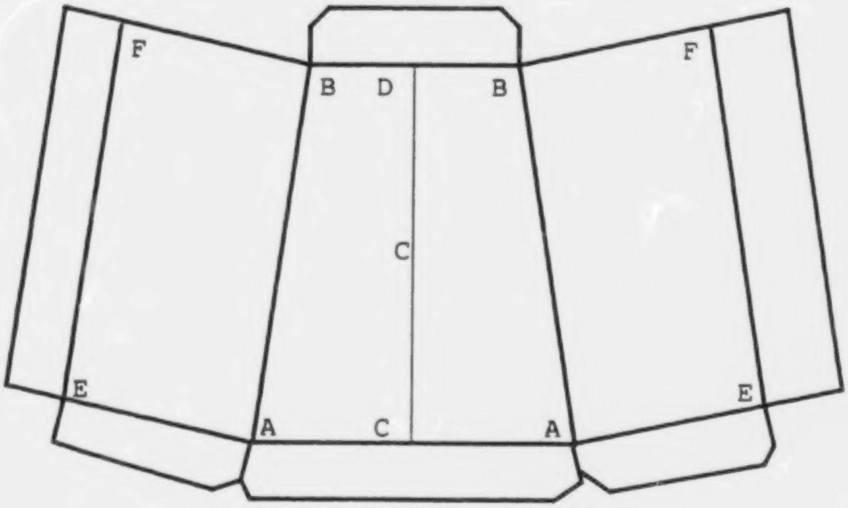
1.



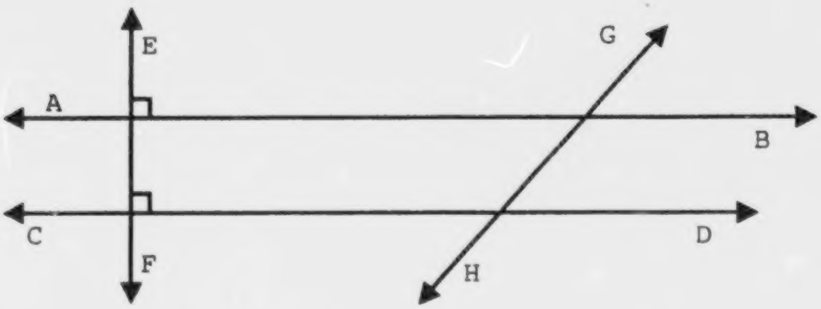
2.



3.


F
F
B
D
B
C
E
E
A
C
A

4.



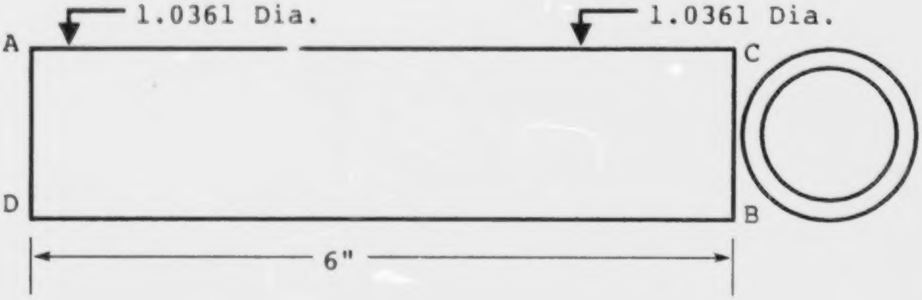
Using the above drawing, identify the following pairs of lines as parallel, perpendicular or neither.

a) EF and CD

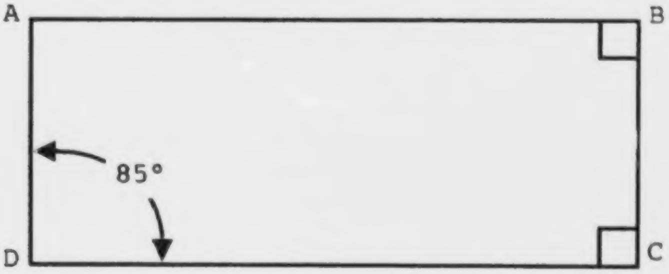
b) EF and GH

c) AB and CD

5. In the shaft illustrated below indicate two pairs of parallel lines.

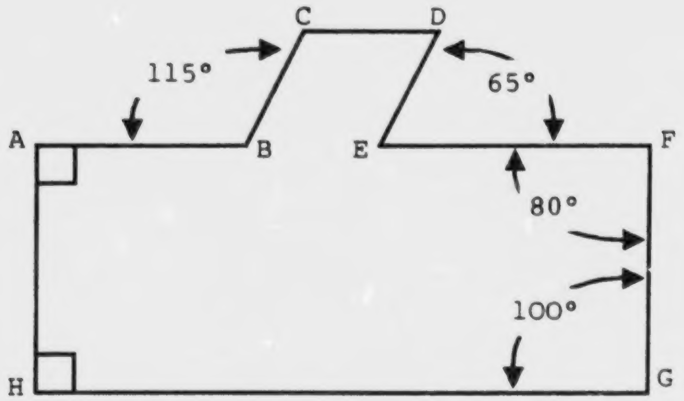

1.0361 Dia.
1.0361 Dia.
A
C
D
B
6"

6. In this sketch, which lines are parallel?

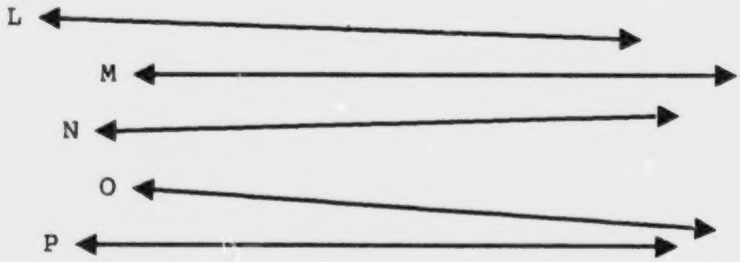


3'6

7. In the sketch below, identify all the lines that are parallel to each other.

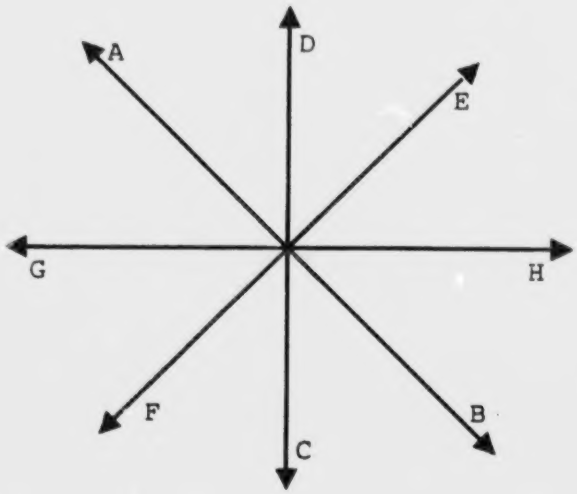

C
D
115°
65°
A
B
E
F
80°
100°
H
G

8. Which line is parallel to line P?



9. Which line is perpendicular to line AB?

10. Which line is perpendicular to line CD?



COMPETENCY #45

Tell relationships of angles formed by perpendicular and parallel lines.

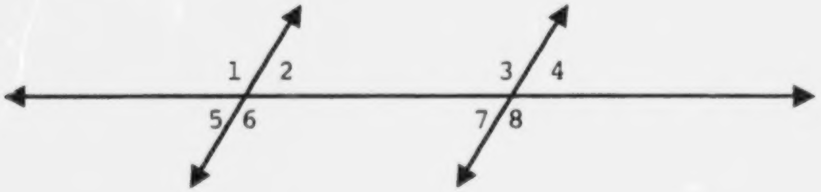
PERFORMANCE OBJECTIVE #62

Given a pair of parallel lines cut by a transversal and the measure of one angle which is formed, find the measures of the other seven angles.

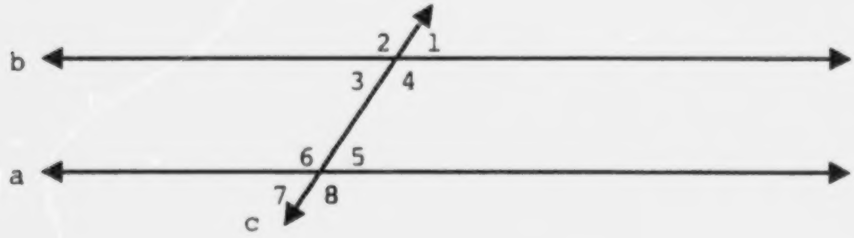
INSTRUCTIONAL ACTIVITIES

Sample Item

1. Given: $m\angle 1 = 140^\circ$
   Find the measures of $\angle$s 2-8. (ans: $m\angle 3 = m\angle 6 = m\angle 8 = 140$
   $m\angle 2 = m\angle 4 = m\angle 5 = m\angle 7 = 40$)



2. In the figure below, find the measure of each angle if $m\angle 1 = 30$.

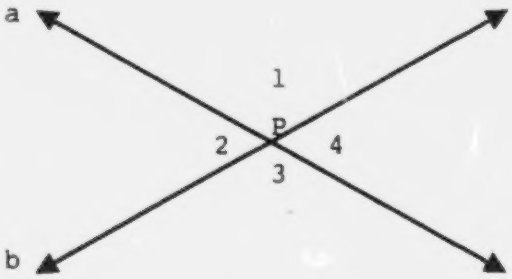


SOLUTION:

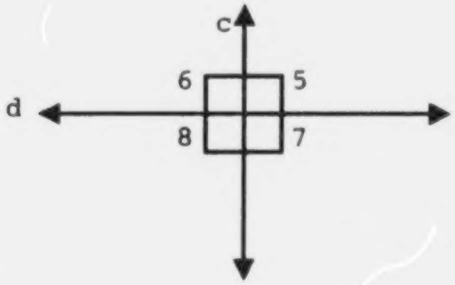
$M\angle 3 = 30$ because vertical angles are congruent.
$M\angle 5 = 30$ because alternate interior angles are congruent or because it corresponds to $\angle 1$.
$M\angle 7 = 30$ because vertical angles are congruent or because it corresponds to $\angle 3$.
$M\angle 2 = 150$ because it is supplementary to $\angle 1$.
$M\angle 4 = 150$ because it is a vertical angle to $\angle 2$.
$M\angle 6 = 150$ because it is an alternate interior angle to $\angle 4$ or because it corresponds to $\angle 2$.
$M\angle 8 = 150$ because it is a vertical angle to $\angle 6$ or because it corresponds to $\angle 4$.

Notes

In a plane, two lines that have one point in common are called intersecting lines. The figure below shows intersecting lines. Lines a and b intersect at point p. Vertical angles are formed by the intersection of two lines. They are angles that are opposite each other. Angles 1 and 3 are vertical angles. Angles 2 and 4 are also vertical angles. Vertical angles are congruent to each other.

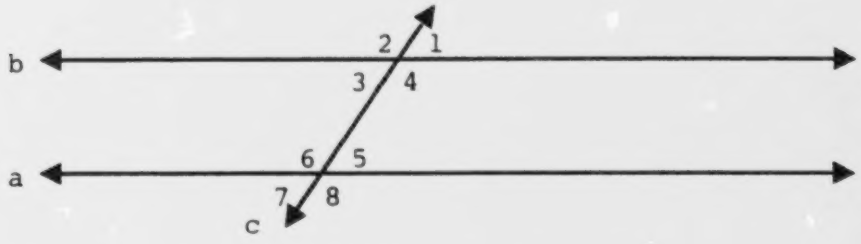


When two lines intersect and right angles are formed, the lines are called perpendicular lines. In the figure below, c is perpendicular to d. This is written $c \perp d$. Also $d \perp c$. $\angle 5$, $\angle 6$, $\angle 7$, and $\angle 8$ are right angles.



In a plane, a line that intersects two or more lines each at a different point is called a transversal. Notice that eight angles are formed when the transversal t intersects lines e and f.

$\angle 1$, $\angle 2$, $\angle 7$, and $\angle 8$ are called exterior angles.
$\angle 3$, $\angle 4$, $\angle 5$, and $\angle 6$ are called interior angles.



When a transversal intersects two parallel lines, the following angle pairs are congruent:

alternate interior angles ($\angle 3 \simeq \angle 5$ and $\angle 4 \simeq \angle 6$)

alternate exterior angles ($\angle 1 \simeq \angle 7$ and $\angle 2 \simeq \angle 8$)

corresponding angles ($\angle 2 \simeq \angle 6$, $\angle 3 \simeq \angle 7$, $\angle 1 \simeq \angle 5$ and $\angle 4 \simeq \angle 8$)

Two angles, the sum of whose measures is 180°, are called supplementary angles. In the figure above, $\angle 2$ is supplementary to both $\angle 1$ and $\angle 3$. Since lines e and f are parallel, $\angle 2$ is also supplementary to $\angle 7$ and $\angle 5$.

REFERENCE TO TEXT

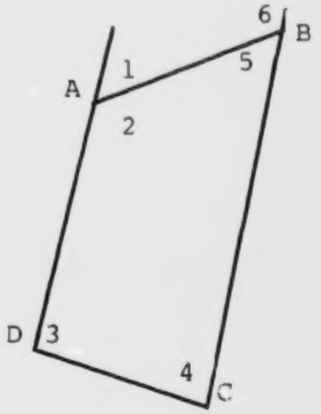
CAREER MATHEMATICS, page 166.

EVALUATION

Given $\overline{AD} \parallel \overline{CB}$; $m\angle 1 = 30°$; $m\angle 3 = 95°$

Find the measures of these angles:

1. $\angle 2$
2. $\angle 4$
3. $\angle 5$
4. $\angle 6$



ANSWERS TO EVALUATION

1. 150°
2. 85°
3. 30°
4. 150°

ANSWERS TO APPLICATIONS

1. $\angle B = 145^\circ$

$\angle C = 35^\circ$

$\angle D = 145^\circ$

$\angle E = 35^\circ$

$\angle F = 145^\circ$

$\angle G = 35^\circ$

$\angle H = 145^\circ$

2. a) $\angle 2 = 135^\circ$

$\angle 3 = 45^\circ$

$\angle 4 = 45^\circ$

$\angle 5 = 135^\circ$

$\angle 6 = 45^\circ$

$\angle 7 = 45^\circ$

$\angle 8 = 135^\circ$

b) $\angle 1 = 148^\circ$

$\angle 2 = 148^\circ$

$\angle 3 = 32^\circ$

$\angle 5 = 148^\circ$

$\angle 6 = 32^\circ$

$\angle 7 = 32^\circ$

$\angle 8 = 148^\circ$

c) $\angle 1 = 112^\circ\ 15'$

$\angle 2 = 112^\circ\ 15'$

$\angle 3 = 67^\circ\ 45'$

$\angle 4 = 67^\circ\ 45'$

$\angle 5 = 112^\circ\ 15'$

$\angle 6 = 67^\circ\ 45'$

$\angle 7 = 67^\circ\ 45'$

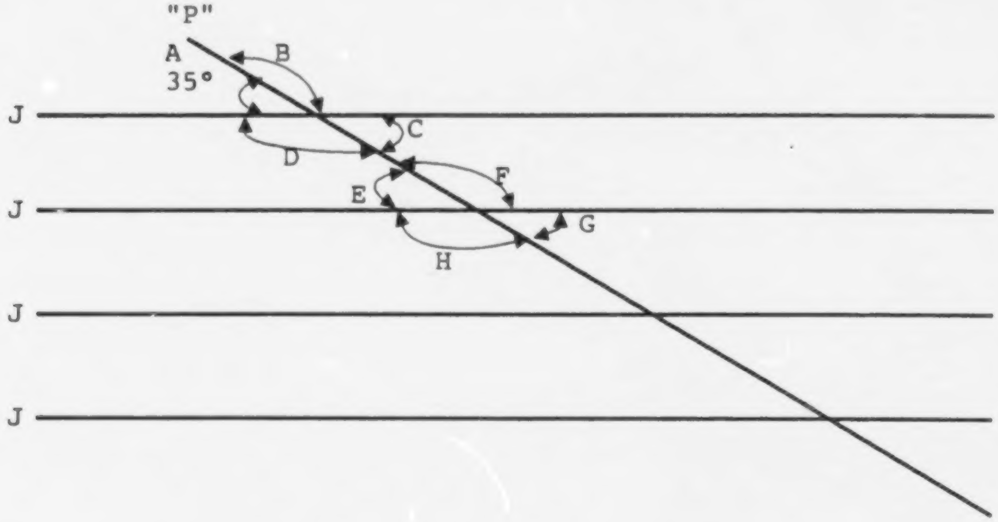
3. $\angle A = 132^\circ\ 40'$

$\angle B = 47^\circ\ 20'$

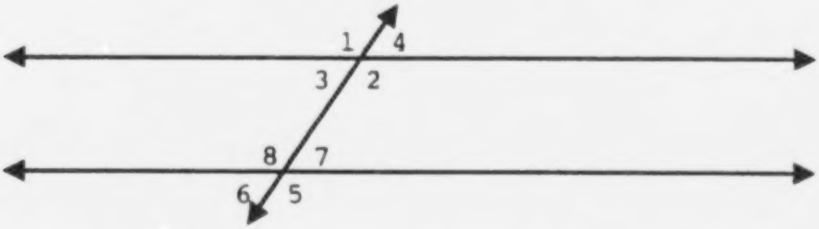
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #62

Performance Objective #62: Given a pair of parallel lines cut by a transversal and the measure of one angle which is formed, find one measure of the other seven angles.

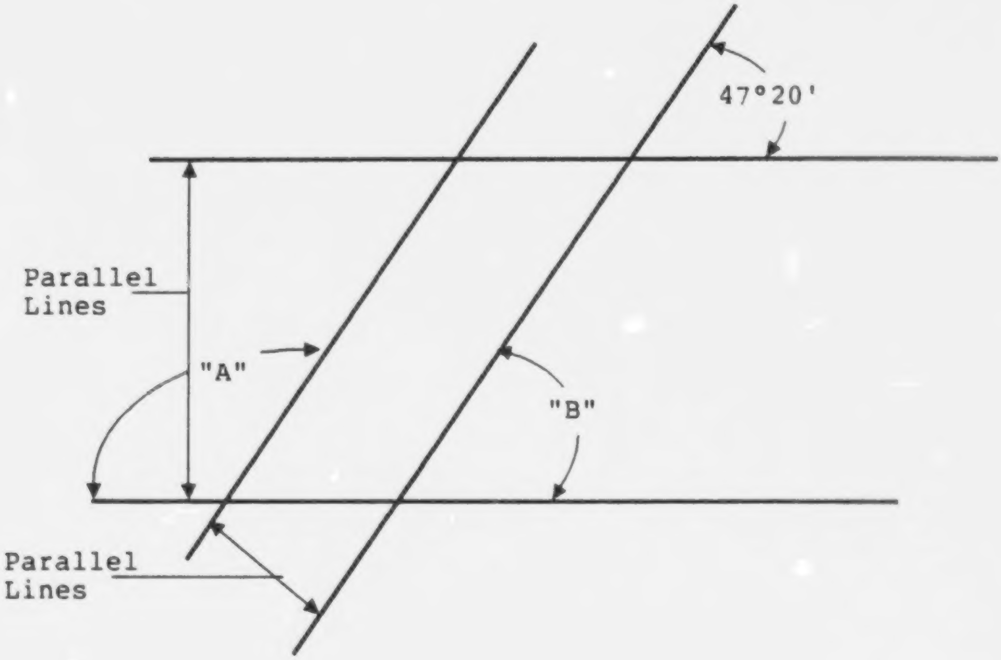
1. Refrigerant lines are to be installed over a ceiling that has bar joists. The pipe is labeled "P" and the joists are labeled "J".
   The angle "A" is 35°. What are the measures of the other seven angles?



2. a) If the measure of angle 1 is 135°, find the measures of angles 2 through 8.
   b) If the measure of angle 4 is 32°, find the measures of the other angles.
   c) If the measure of angle 8 is 112° 15', find the measures of angles 1 through 7.



3. In the illustration below, the machinist must find the angles "A" and "B" and give their measurement in degrees and minutes.


47°20'
Parallel Lines
"A"
"B"
Parallel Lines

COMPETENCY #46

Classify angles according to their measures.

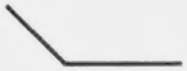
PERFORMANCE OBJECTIVE #63

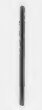
Given an angle (drawing or measure), classify it as acute, obtuse, straight or right.

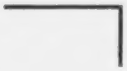
INSTRUCTIONAL ACTIVITIES

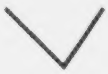
Sample Item

Identify each of the following angles as acute, obtuse, straight or right.

a) 

b) 

c) 

d) 

(ans: a) obtuse, b) straight, c) right, d) acute)

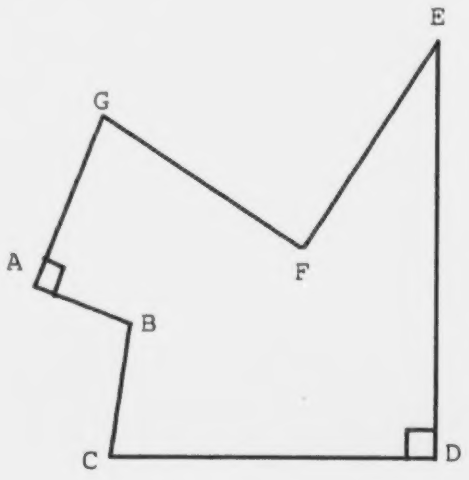
REFERENCE TO TEXT

CAREER MATHEMATICS, page 159.

EVALUATION

Identify each angle as acute, obtuse, right or straight.

1. $\angle A$
2. $\angle C$
3. $\angle E$
4. $\angle G$



ANSWERS TO EVALUATION

1. right
2. acute
3. acute
4. obtuse

ANSWERS TO APPLICATIONS

1. a) right
   b) obtuse
   c) acute
   d) obtuse
   e) right
   f) right
   g) straight
   h) acute

2. a) acute
   b) obtuse
   c) straight
   d) right

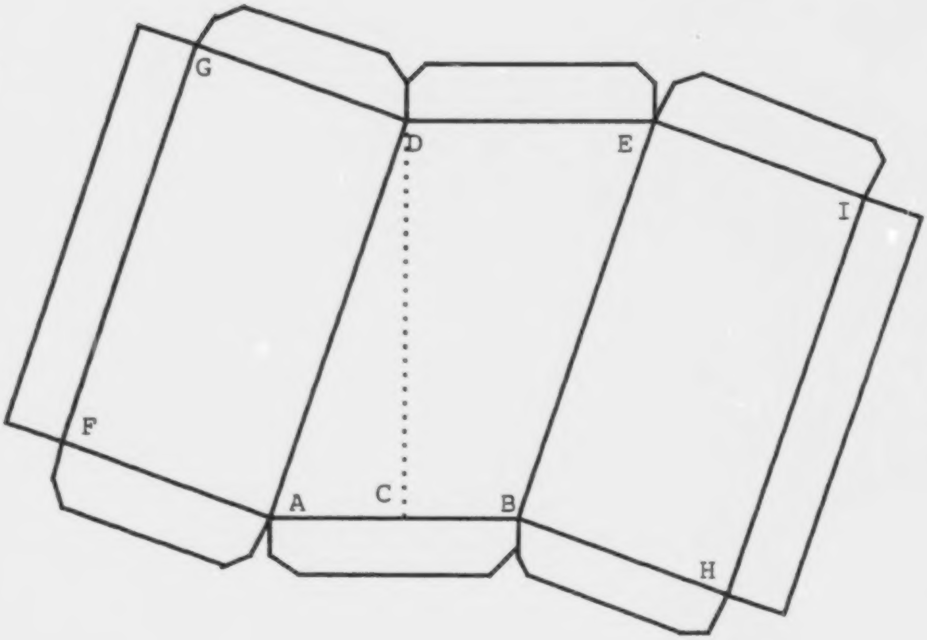
3. a) acute
   b) acute
   c) right
   d) obtuse
   e) straight
   f) neither
   g) neither
   h) acute
   i) obtuse
   j) obtuse
   k) acute
   l) right
   m) acute
   n) right
   o) obtuse
   p) obtuse
   q) straight

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #63

Performance Objective #63: Given an angle (drawing or measure), classify it as acute, obtuse, straight or right.

1. From the following drawing, classify the identified angles as acute, obtuse, straight or right.

a)	∠FGD	e)	∠EBH
b)	∠EDA	f)	∠BEI
c)	∠DAB	g)	∠ACB
d)	∠ABE	h)	∠BED



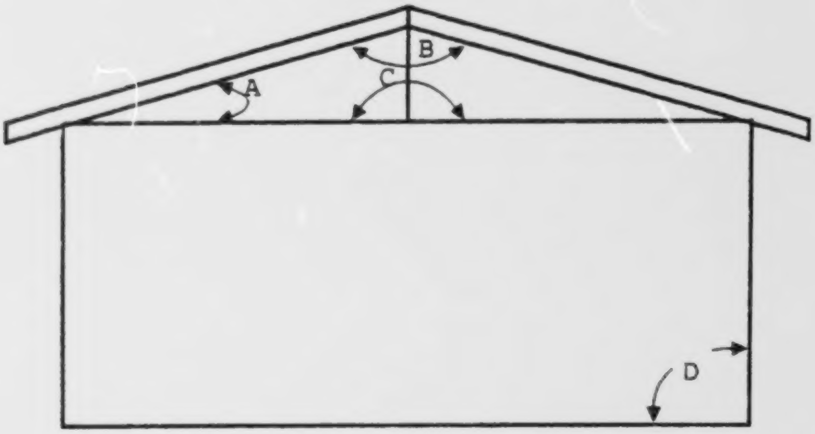
2. Classify angles A, B, C and D as acute, obtuse, straight or right.

a) ∠A

b) ∠B

c) ∠C

d) ∠D



3. Classify each of the following angles as obtuse, acute, straight or right or neither.

a) 27°

b) 49°

c) 90°

d) 136°

e) 180°

f) 360°

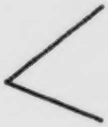
g) 270°

h) 15°

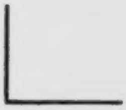
i) 91.6°

j) 102°

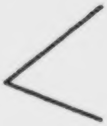
k)



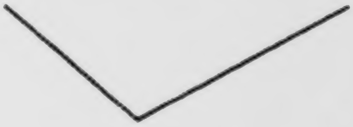
l)



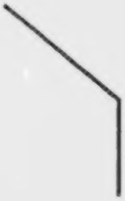
m)



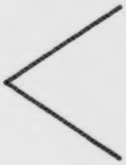
n)



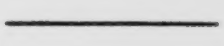
o)



p)



q)



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #47

Identify angle pairs and state relationships regarding angle measures.

PERFORMANCE OBJECTIVE #64

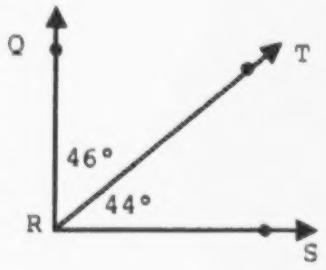
Given drawings of supplementary, complementary, vertical and adjacent angles, identify each pair of angles.

INSTRUCTIONAL ACTIVITIES

Sample Item

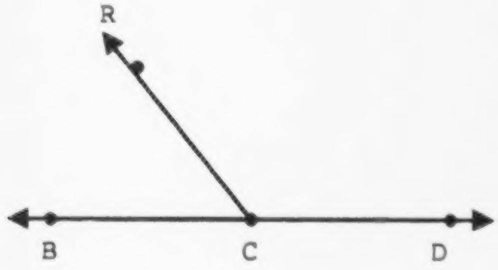
Complementary Angles are angles whose sum is 90°. In the drawing below, line TR divides the right angle QRS into two complementary angles; ∠QRT and ∠TRS. ∠QRT is called the complement of ∠TRS.

EXAMPLE:



Supplementary Angles are angles whose sum is 180°. In the drawing below, line RC divides the straight angle BCD into two supplementary angles ∠BCR and ∠RCD. ∠BCR is called the supplement of ∠RCD.

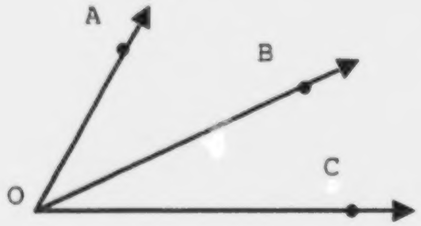
EXAMPLE:



INSTRUCTIONAL ACTIVITIES (cont.)

Adjacent Angles: two angles are adjacent if and only if they have a common side and a common vertex, but no interior points in common.

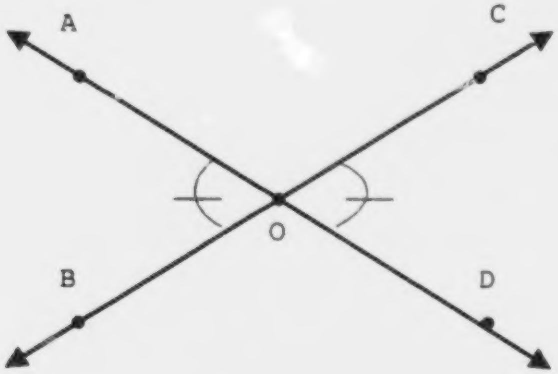
Example:



∠AOB and ∠BOC are adjacent angles.

Vertical Angles: two angles are vertical if and only if they are two nonadjacent angles formed by two intersecting lines. If two angles are vertical, then they are congruent.

EXAMPLE:



∠AOB and ∠COD are vertical angles and therefore are congruent.

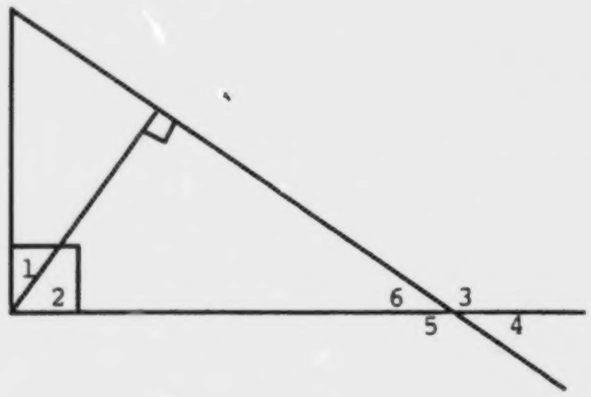
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 170-171.

EVALUATION

Identify each pair of angles as vertical, adjacent, supplementary or complementary.

1. ∠1 and 2
2. ∠6 and 3
3. ∠6 and 4
4. ∠3 and 5



320

ANSWERS TO EVALUATION

1. Complementary and adjacent
2. Adjacent and supplementary
3. Vertical
4. Vertical

ANSWERS TO APPLICATIONS

1. a) $\angle EOB$ and $\angle AOF$
   b) $\angle AOF$ and $\angle EOB$
   c) $\angle EOB$
2. a) Vertical
   b) Adjacent and supplementary
   c) Adjacent and complementary
3. a) Complementary (equaling 90°)
   b) Supplementary (equaling 180°)
   c) Vertical (Since $\overline{AD}$ and $\overline{BC}$ intersect at 0, $\angle AOB$ and $\angle COD$ are vertical angles and are congruent.)

APPLICATION
FOR
PERFORMANCE OBJECTIVE #64

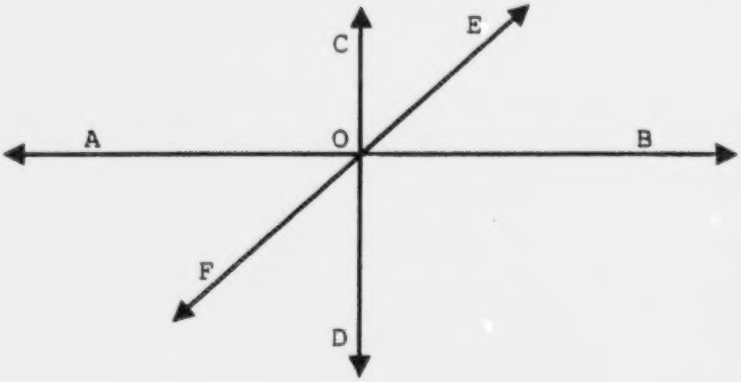
Performance Objective #64: Given drawings of supplementary, complementary, vertical and adjacent angles, identify each pair of angles.

1. Given that AB is perpendicular to CD, complete:

   a) ∠AOE is supplementary to ∠______ and ∠_____.

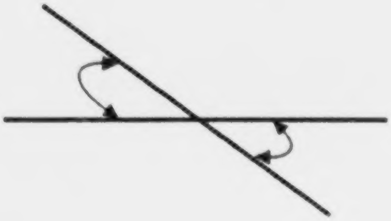
   b) ∠DOF is complementary to ∠______ and ∠_____.

   c) ∠AOF and ________ are vertical angles.

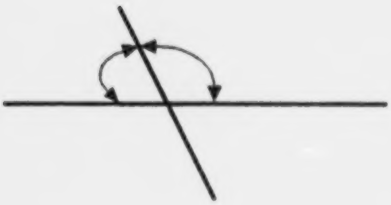


2. Identify each of the following sets of angles as supplementary, complementary, vertical and adjacent angles.

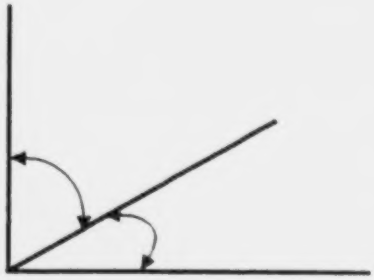
a)



b)

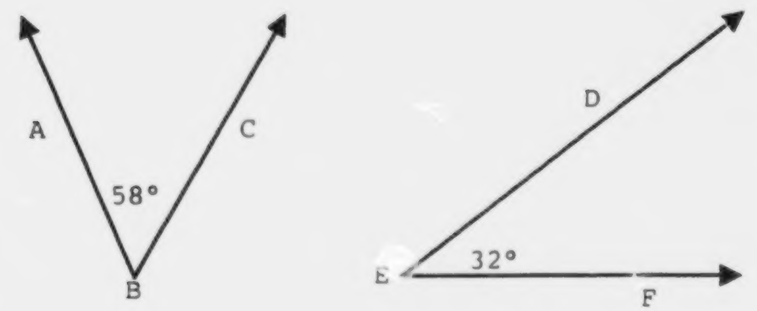


c)

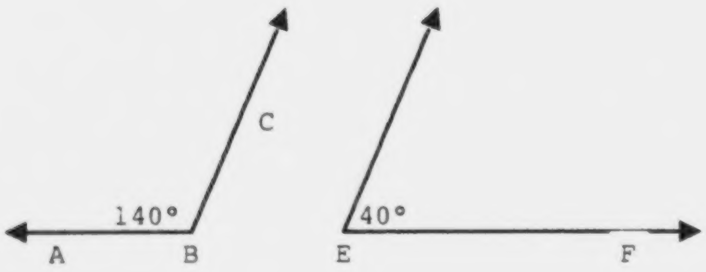


3. Identify each pair of angles as supplementary, complementary, vertical or adjacent. Explain.

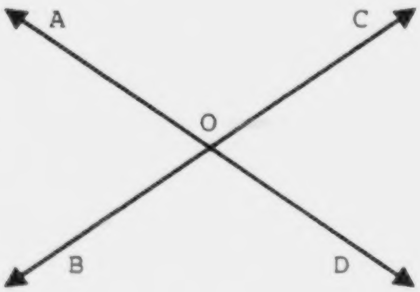
a)


A
C
58°
B
D
32°
E
F

b)


C
140°
A
B
40°
E
F

c)



COMPETENCY #47

Identify angle pairs and state relationships regarding angle measures.

PERFORMANCE OBJECTIVE #65

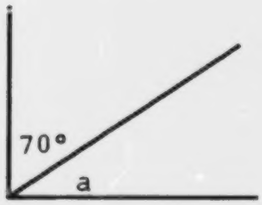
Given the measure of one angle in a pair of supplementary, complementary or vertical angles, find the measure of the other angle.

INSTRUCTIONAL ACTIVITIES

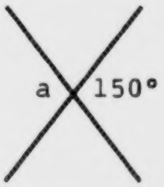
Sample Item

Find the measure of ∠a in each drawing.

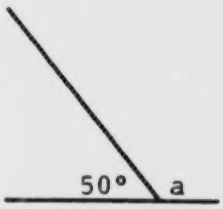
a)



b)



c)



(ans: a) 20°; b) 150°; c) 130°)

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 170-171.

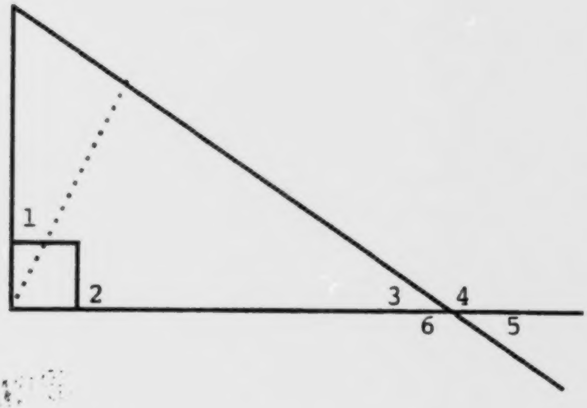
EVALUATION

Given: m∠1 = 25°

m∠3 = 26°

Find:

1. m∠2
2. m∠4
3. m∠5
4. m∠6



ANSWERS TO EVALUATION

1. 65°
2. 154°
3. 26°
4. 154°

ANSWERS TO APPLICATIONS

1. $\angle A = 35° \ 30'$

   $\angle B = 39° \ 45'$
2. 64° 39'
3. 67° 11' 30"
4. a) 115°

   b) 22°

   c) 18°
5. a) $\angle DEF = 135°$

   b) $\angle DEF = 49°$

   c) $\angle COD = 28°$

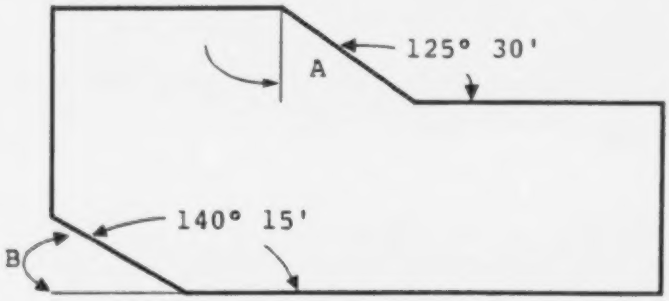
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #65

Performance Objective #65: Given the measure of one angle in a pair of supplementary, complementary or vertical angles, find the measure of the other angle.

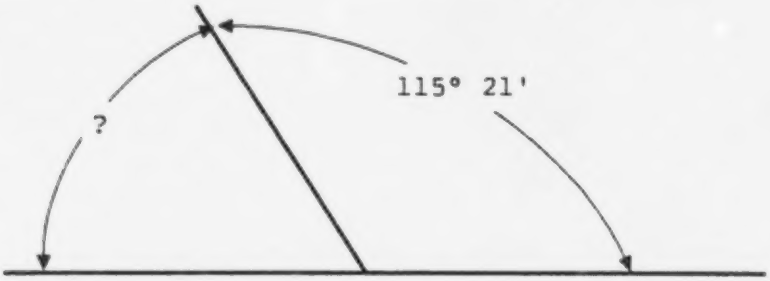
1. The machinist assigned to make this die insert must find angles A and B to set up the machine to produce the angles required.

$\angle A$ = ________

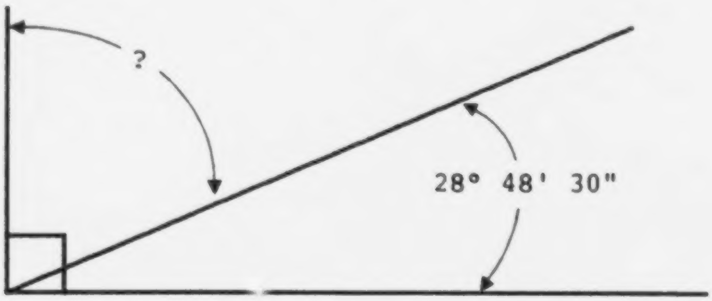
$\angle B$ = ________



2. The machinist must be able to find the supplementary angle.



3. The machinist must be able to find the complementary angle.

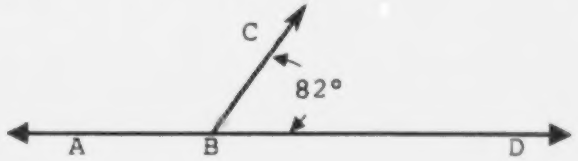


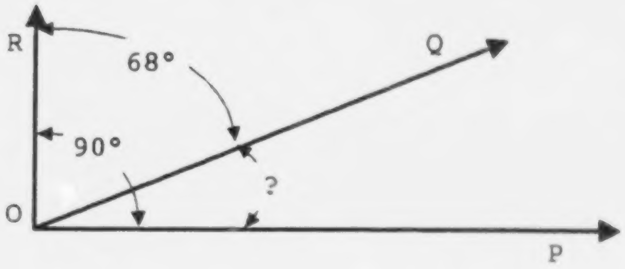
4. Without using a protractor, find the measure of :

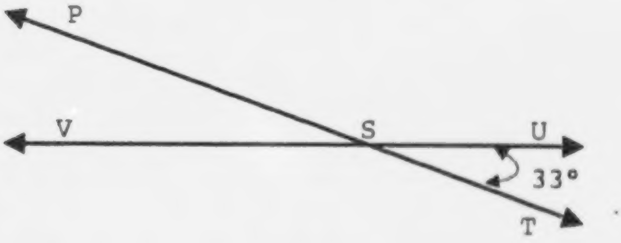
a) ∠ABC

b) ∠POQ

c) ∠RSV

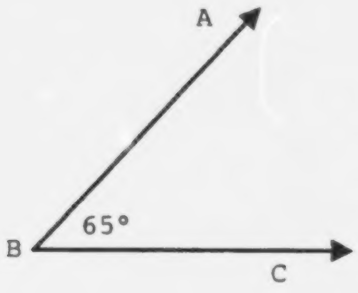


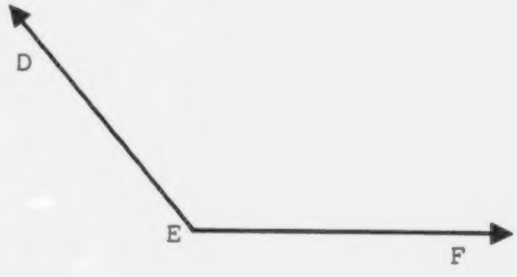




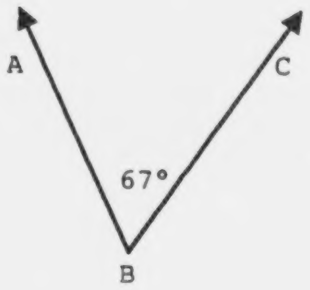
5. Give the missing measurement in the pairs of angles below.

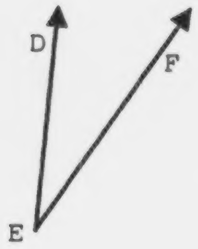
a) Supplementary ∠



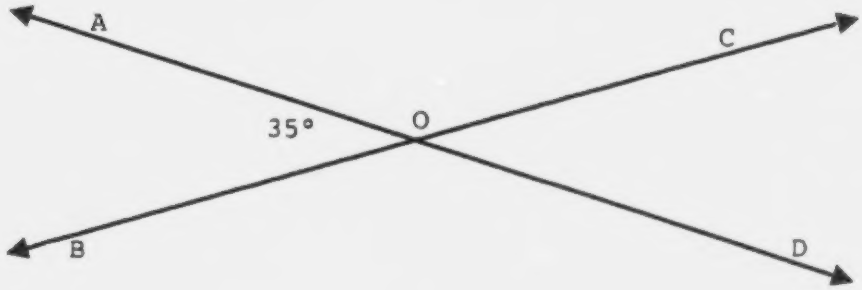


b) Complementary ∠





c) Vertical ∠



COMPETENCY #48

Measure angles.

PERFORMANCE OBJECTIVE #66

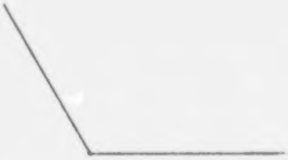
Given an angle and a protractor, find the measure of the angle to the nearest half-degree.

INSTRUCTIONAL ACTIVITIES

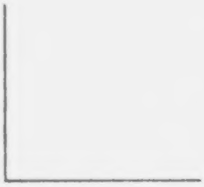
Sample Item

Measure these angles:

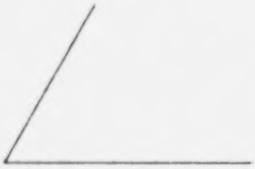
1. (ans: 120°)



2. (ans: 90°)



3. (ans: 60°)



Notes

General: Students should be able to recognize acute, right, and obtuse angles. Estimating an angle's measurement is an important skill that should be acquired by the student in working with various problems containing angular measurement.

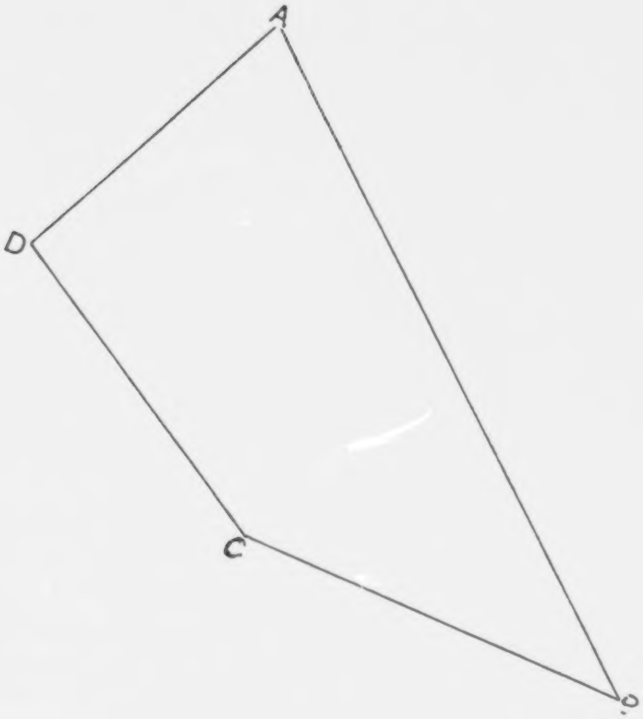
Trade and Industry: In trade and industry employees will need an ability to measure angles. In the machine trades a person must know the angles between the threads of bolts and screws. In woodworking, cabinetmaking, and building construction one must be able to reproduce the various angles used in miter cuts, joints, and angular cuts used in these trades.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 159-161.

EVALUATION

Measure ∠s A, B, C and D.



ANSWERS TO EVALUATION

1. A = 75°
2. B = 40°
3. C = 150°
4. D = 95°

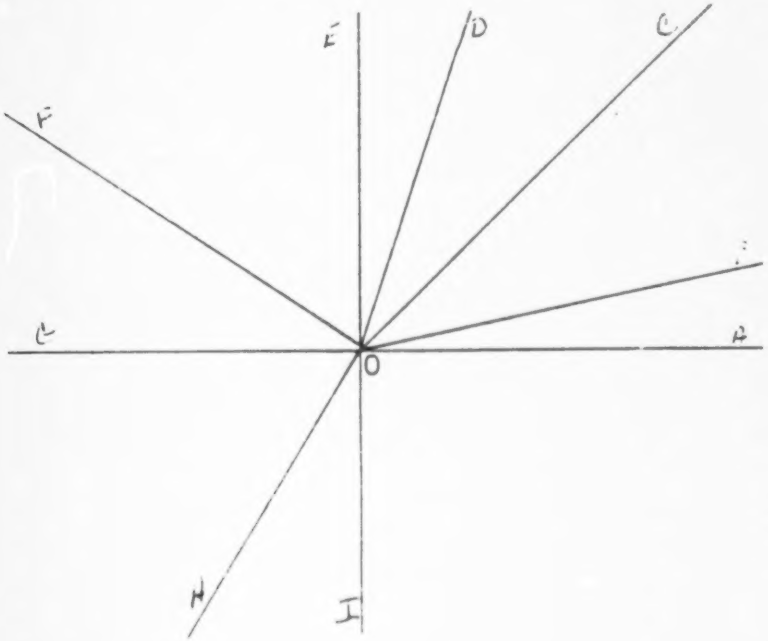
ANSWERS TO APPLICATIONS

1. 12°
2. 44°
3. 146 1/2°
4. 180°
5. 120°
6. 90°
7. 132°
8. 60°
9. 75 1/2°
10. 33 1/2°
11. 90°
12. 60°

Note: Answers may vary due to measuring instruments or alterations occurring during printing.

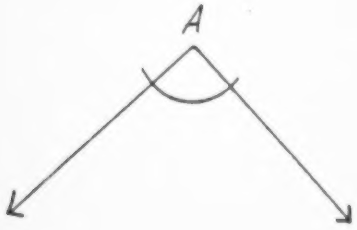
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #66

Performance Objective #66: Given an angle and a protractor, find the measure of the angle to the nearest half-degree.

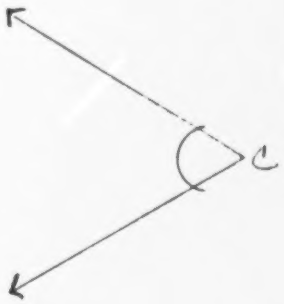


1. ∡AOB = ____________
2. ∡AOC = ____________
3. ∡AOF = ____________
4. ∡AOG = ____________
5. ∡AOH = ____________
6. ∡AOI = ____________
7. ∡BOH = ____________
8. ∡BOD = ____________
9. ∡DOF = ____________
10. ∡FOG = ____________

11. Measure angle A:



12. Measure angle C:



COMPETENCY #49

Draw angles.

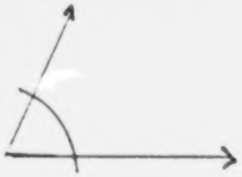
PERFORMANCE OBJECTIVE #67

Given a protractor, draw an angle of given measure correctly to the nearest half-degree.

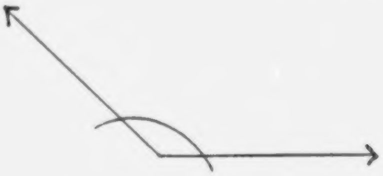
INSTRUCTIONAL ACTIVITIES

Sample Item

1. Draw an angle with a measure of 65 1/2°. ans:



2. Draw an angle with a measure of 135°. ans:



Notes

General: Students should be able to identify acute, right, and obtuse angles. This will simplify using the protractor and make the task of estimating these angles easier in the future.

Trade and Industry: In trade and industry employees will often have to draw (construct) angles. In the field of drafting, draftsmen and engineers encounter problems concerning angular construction daily. Cabinetmakers and people in the building construction trades have to lay off angles used in mitering, joint construction and everyday practices found in their work.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 159-161.

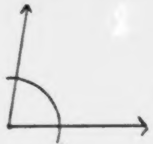
EVALUATION

Draw angles with these measures. Use a protractor.

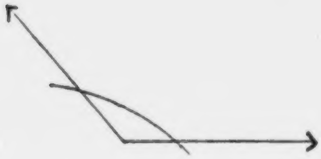
1. 80°
2. 132°
3. 61°
4. 155°

ANSWERS TO EVALUATION

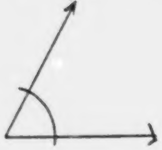
1.



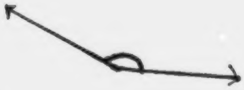
2.



3.

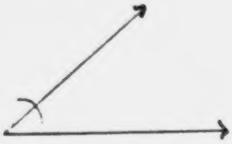


4.

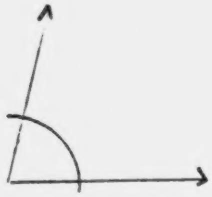


ANSWERS TO APPLICATIONS

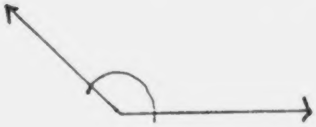
1.



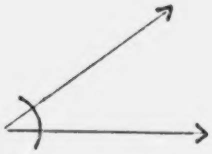
2.



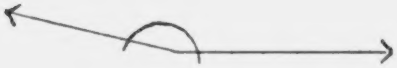
3.



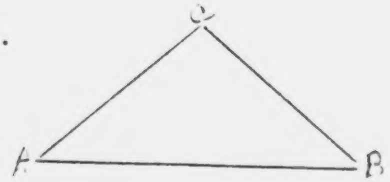
4.



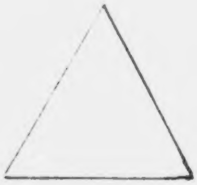
5.



6.



7.



APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #67

Performance Objective #67: Given a protractor, draw an angle of given measure correctly to the nearest half-degree.

1. 40°

2. 76°

3. 135°

4. 37°

5. 167°

6. An isosceles triangle has two angles that are equal. Construct an isosceles triangle where ∠s A and B are the base angles and are equal. These base angles are each 40°. Side C is 2 inches long.

7. An equilateral triangle has equal angles. Construct an equilateral triangle with sides equal to 1 1/4 inches.

COMPETENCY #50

Classify triangles according to the length of their sides and the measure of their angles.

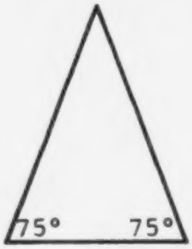
PERFORMANCE OBJECTIVE #68

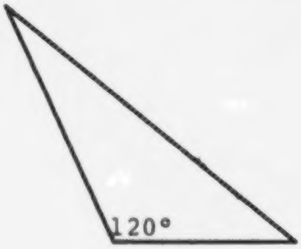
Given a triangle, classify it as acute, obtuse, right, scalene, isosceles, or equilateral.

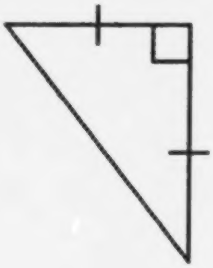
INSTRUCTIONAL ACTIVITIES

Sample Item

1. Classify each of the following triangles by the lengths of their sides, then classify each by their angles.



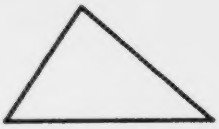
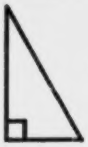
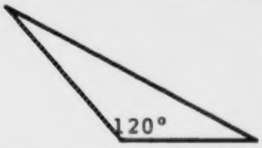
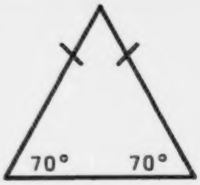
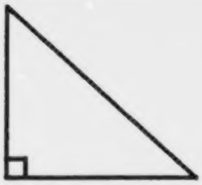
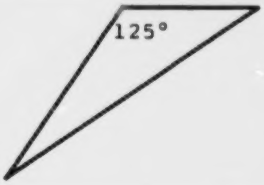
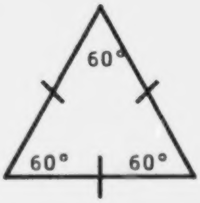




isosceles	scalene	isosceles
acute	obtuse	right

Notes

Angles may be classified either by sides or by angles. Scalene triangles have no sides equal, isosceles triangles have at least two equal sides, and equilateral triangles have all three sides equal. Acute triangles have three acute angles, obtuse triangles have one angle greater than ninety degrees, and right triangles have one angle equal to ninety degrees. The chart on the following page is a handy way to classify triangles both ways.

	Acute	Right	Obtuse
SCALENE			
ISOSCELES			
EQUILATERAL		NOT POSSIBLE	NOT POSSIBLE

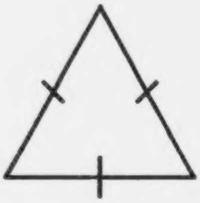
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 283, 288.

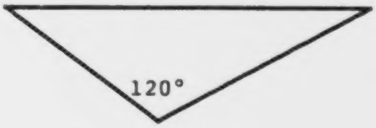
EVALUATION

Classify each triangle according to its sides and angles.

1.



2.



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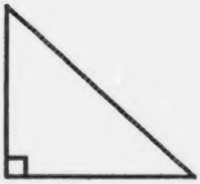

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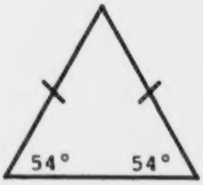


ANSWERS TO EVALUATION

1. Equilateral, acute
2. Scalene, right
3. Scalene, obtuse
4. Isosceles, acute

ANSWERS TO APPLICATIONS

I. 1. b

2. c

3. d

4. e

5. a

6. f

II. No, No

III. Isosceles
Right

Equilateral
Acute

Scalene
Obtuse

Scalene
Acute

Scalene
Right

Isosceles
Acute

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #68

Performance Objective #68: Given a triangle, classify it as acute, obtuse, right, scalene, isosceles, or equilateral.

I. Match the kind of triangle to its description.

_____1. Scalene triangle

_____2. Equilateral triangle

_____3. Isosceles triangle

_____4. Acute triangle

_____5. Right triangle

_____6. Obtuse triangle

a. Has one ninety degree angle

b. Has no sides the same length

c. Has all sides the same length

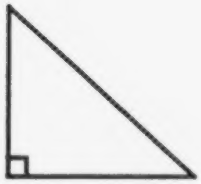
d. Has at least two sides the same length

e. Has all acute angles

f. Has one angle greater than ninety degrees

II. Can an equilateral triangle ever be an obtuse triangle? a right triangle?

III. Classify each of the following triangles first by sides and then by angles.



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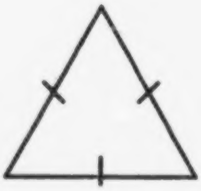

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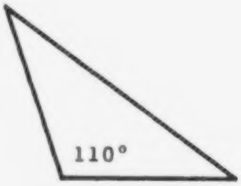

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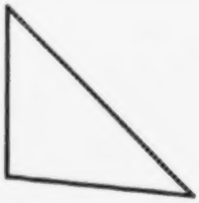

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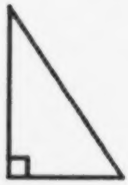

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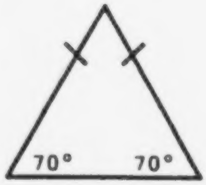

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COMPETENCY #51

Identify the parts of triangles, including construction of medians, altitudes and angle bisectors.

PERFORMANCE OBJECTIVE #69

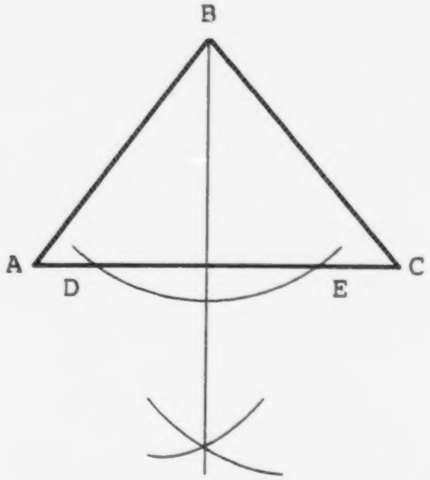
Given a triangle, construct the medians, altitudes and angle bisectors.

INSTRUCTIONAL ACTIVITIES

Sample Item

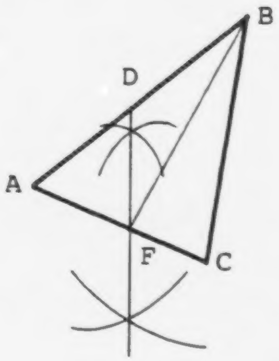
a) Construct the altitude from B to $\overline{AC}$ in Δ ABC

1. Place compass point on B and construct arc DE
2. Open compass slightly and first place at D, then at E (cross arcs)
3. Draw BX - this is the altitude.



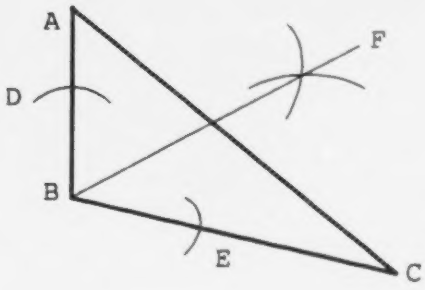
b) Construct the median from B to $\overline{AC}$ in Δ ABC.

1. Open compass more than 1/2 the length of AC
2. Place compass at A - then at C (cross arcs)
3. Draw DE to determine F
4. Draw BF - this is the median

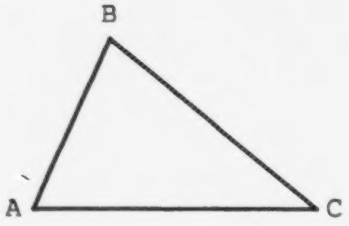


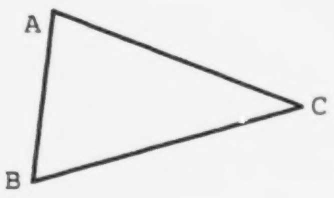
c) Construct the bisector of angle B in Δ ABC.

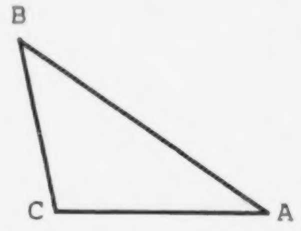
1. Place compass at B, mark D and E
2. Place compass first at D, then at E to determine F
3. BF is the bisector of $\angle B$

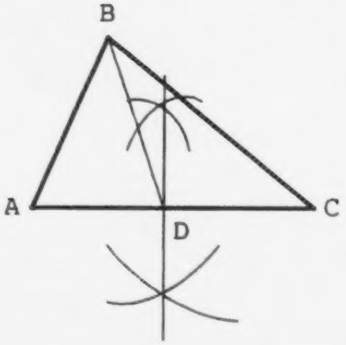


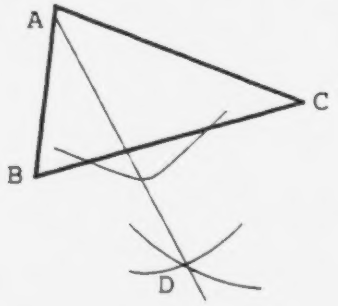
d) Given three triangles ABC construct a median in the first, an altitude in the second, and an angle bisector in the third.

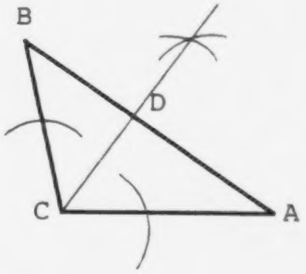












(ans:
BD is the median from B to AC.

AD is the altitude from A to BC.

CD is the angle bisector of $\angle C$.)

Notes

Students should define, identify, and construct medians, altitudes, and angle bisectors. The students should understand the meaning of midpoint and bisect. Be sure students use all types of triangles and construct, using a straight edge and compass, all three medians (for example) in the same triangle since their point of intersection is the center of gravity for the triangle.

In order to construct each segment the student should be able to define each part of the triangle. This aids the student in remembering what to construct.

Altitude - a line segment drawn from the vertex of a triangle perpendicular to the opposite side.

Median - a line segment drawn from the vertex to the midpoint of the opposite side.

Angle bisector - a line segment drawn from the vertex to the opposite side which divides the angle into two equal parts.

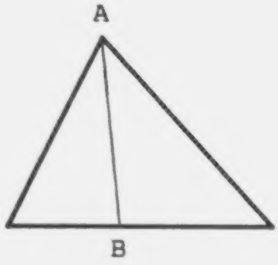
REFERENCE TO TEXT

CAREER MATHEMATICS, page 165.

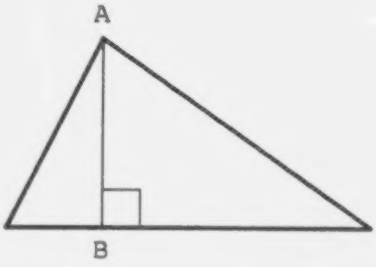
EVALUATION

Identify segment AB in each triangle.

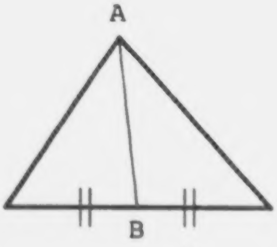
1.



2.



3.



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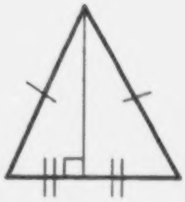
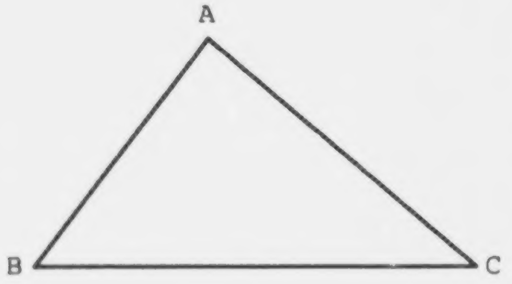
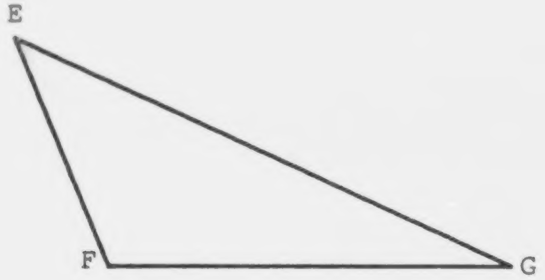


Construct:

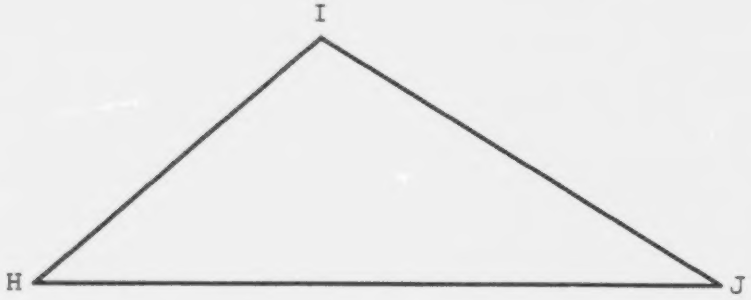
5. the median to side BC of Δ ABC



6. the altitude to side EG of Δ



7. the angle bisector of $\angle$HIJ in Δ HIJ



ANSWERS TO EVALUATION

1. Angle bisector
2. Altitude
3. Median
4. Angle bisector, altitude & median

5. - 7. Check constructions with compass

ANSWERS TO APPLICATIONS

Check constructions with compass.

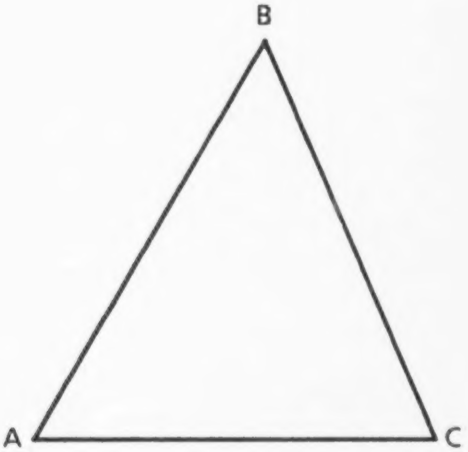
II. Since $\angle DEF$ is a right triangle, DE and DF, the legs, are also altitudes by definition.

V. The point where the medians meet is the centroid, the point where the triangle could be balanced.

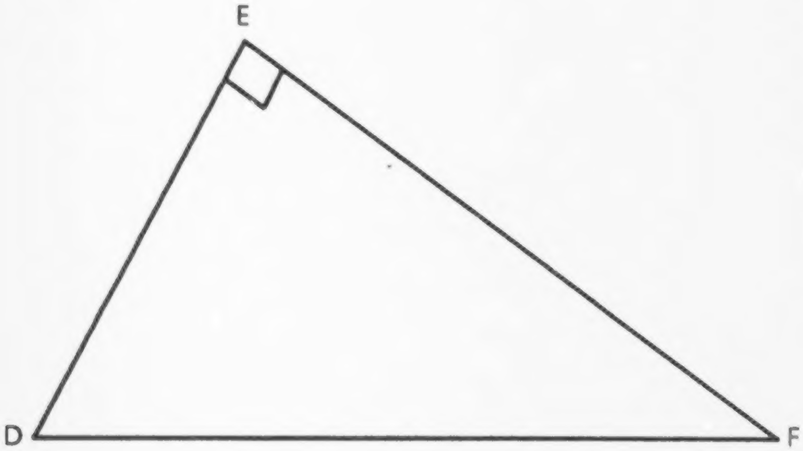
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #69

Performance Objective #69: Given a triangle, construct the medians, altitudes and angle bisectors.

I. Construct all three altitudes in Δ ABC.

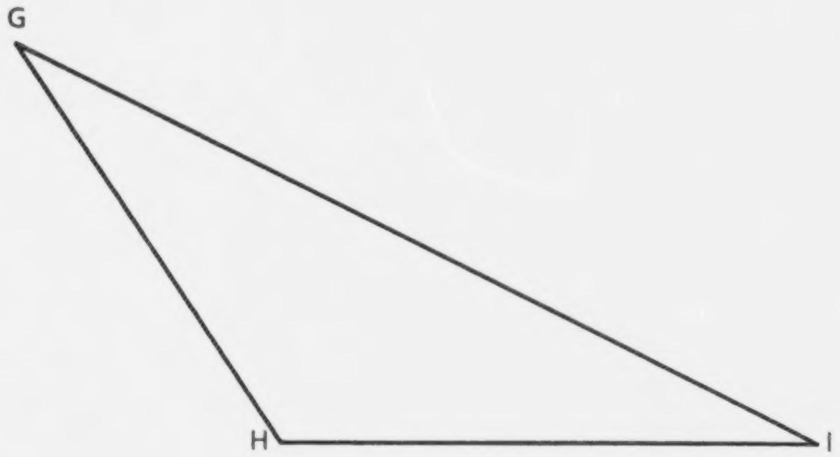


II. Construct the altitude from E to $\overline{DF}$ in Δ DEF.

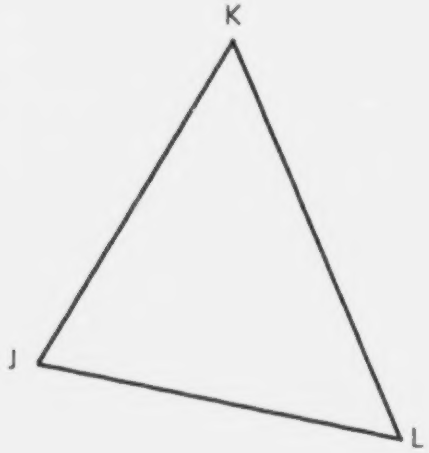


Why is it not necessary to construct the other two altitudes?

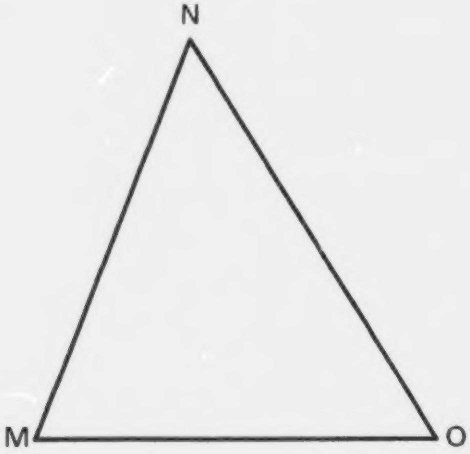
III. Construct all three altitudes in Δ GHI. You may have to extend some of the sides of the triangle.



IV. Construct all three angle bisectors for Δ JKL.



V. Construct all three medians for Δ MNO.



What is special about the point where all three medians meet?

COMPETENCY #51

Identify the parts of triangles, including construction of median, altitude and angle bisectors.

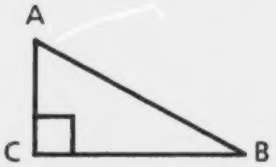
PERFORMANCE OBJECTIVE #70

Given a right triangle, identify the legs and hypotenuse.

INSTRUCTIONAL ACTIVITIES

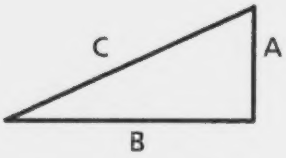
Sample Item

Identify each side in this right triangle as a leg or hypotenuse.



(an: $\overline{AB}$ is hypotenuse; $\overline{AC}$ and $\overline{CB}$ are legs)

Identify each side in this right triangle as a hypotenuse, altitude leg and base leg.



(ans: C is hypotenuse; A is altitude leg; B is base leg)

Notes

General: For students having difficulty with "the side opposite" provide some type of manipulative which they can use to make triangles and then pick up sides.

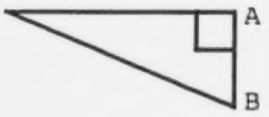
Building Construction: In building construction the lengths of common rafters in the roof frame are determined by using a table on the rafter square. This table is derived from the Rule of Pythagoras, or the right triangle rule as it is commonly known.

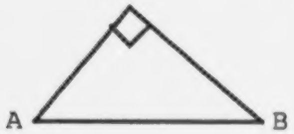
REFERENCE TO TEXT

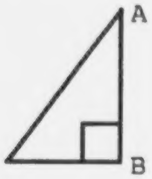
CAREER MATHEMATICS, pages 283-285.

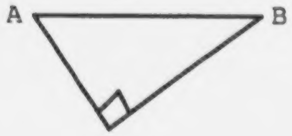
EVALUATION

Identify side AB in each right triangle as a leg or hypotenuse.

1. 

2. 

3. 

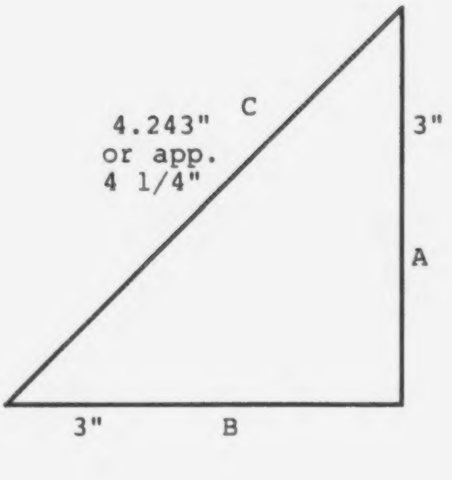
4. 

ANSWERS TO EVALUATION

1. leg
2. hypotenuse
3. leg
4. hypotenuse

ANSWERS TO APPLICATIONS

1. a) hyp: $\overline{AB}$
   legs: $\overline{AC}$ and $\overline{BC}$
   b) hyp: $\overline{EH}$
   legs: $\overline{EF}$ and $\overline{FH}$
   c) hyp: $\overline{HI}$
   legs: $\overline{GH}$ and $\overline{GI}$
2. a) leg
   b) hypotenuse
   c) leg
3.



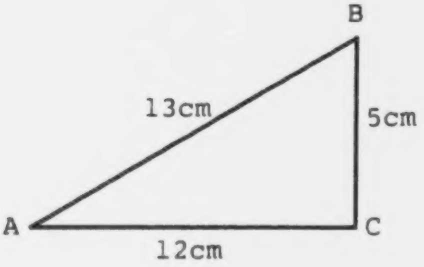
$$a^2 + b^2 = c^2$$
$$(3 \times 3) + (3 \times 3) = 18$$
$$\sqrt{18} = 4.243"$$

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #70

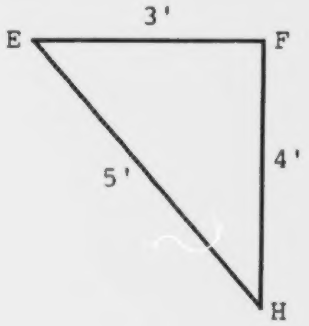
Performance Objective #70: Given a right triangle, identify the legs and hypotenuse.

1. Verify that each triangle is a right triangle. Identify each side as either the hypotenuse or a leg.

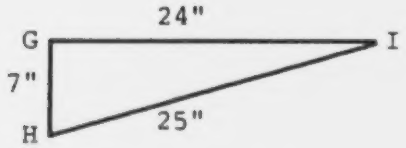
a)


B
13cm
5cm
A
C
12cm

b)



c)

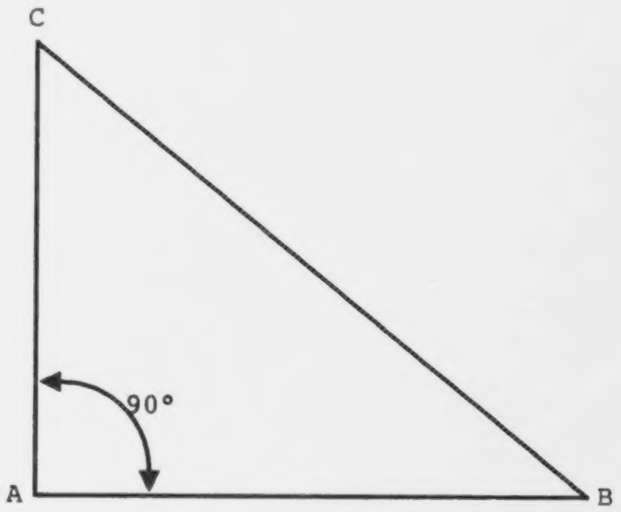


2. Identify by naming each of the following line segments.

a) AB

b) BC

c) CA



3. Draw a right triangle with one leg, A, 3" long; a second leg, B, 3" long, intersecting leg A at 90°. Connect the ends of line segment (leg) A and line segment (leg) B to form the hypotenuse C. What is the length of the hypotenuse? Prove your answer.

COMPETENCY #52

Find missing angle of a triangle.

PERFORMANCE OBJECTIVE #71

Given the measure of two angles of a triangle, find the measure of the third angle.

INSTRUCTIONAL ACTIVITIES

Sample Item

Given a triangle with the measures of 2 angles, find the measure of the third angle without measuring.

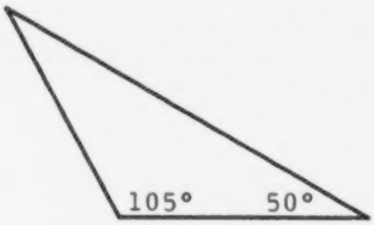
Solution: The sum of the 3 angles of a triangle is 180°. To find the missing angle, add the 2 known angles together.

$105° + 50° = 155°$

Then subtract the sum from 180°.

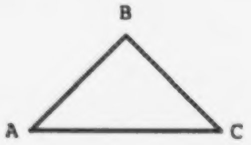
$180° - 155° = 25°$

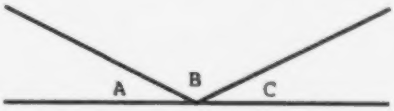
The missing angle is 25°.



Notes

Have students measure the angles of several triangles and add the measures so that they see that the sum is 180°. Another activity is to give the students triangles cut from paper and have them tear the three angles off and form a straight angle.





This activity works well with waxed paper on the overhead projector. Students should know that the acute angles of a right triangle are complementary and that the base angles of isosceles triangles are congruent.

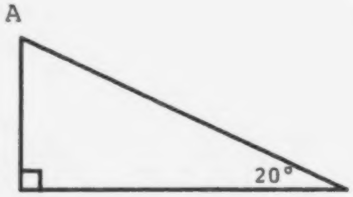
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 159-160.

EVALUATION

Find the measure of angle A in each triangle.

1.



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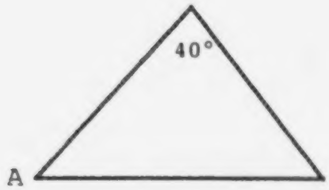
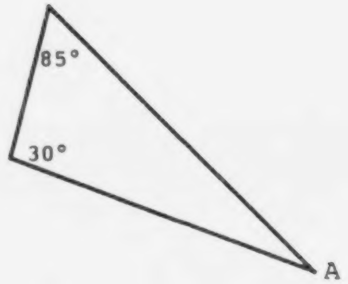
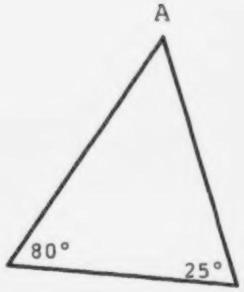


3.



4.



ANSWERS TO EVALUATION

1. 70°
2. 70°
3. 65°
4. 75°

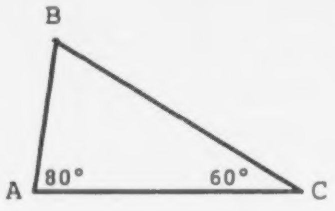
ANSWERS TO APPLICATIONS

1. 40°
2. 53°
3. a) 31 1/2°
   b) 31 1/2°
4. 23°
5. a) 33°
   b) 57°

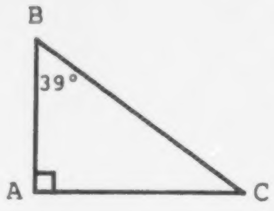
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #71

Performance Objective #71: Given the measure of two angles of a triangle, find the measure of the third angle.

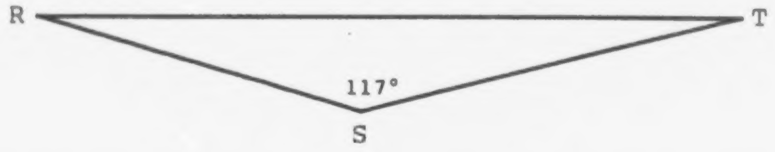
1. Find the measure of ∡B.



2. Find the measure of ∡C.

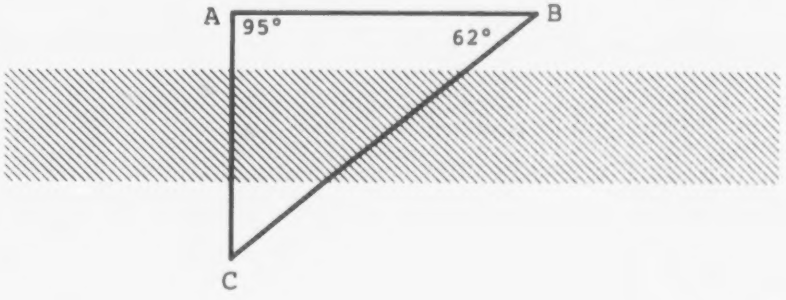


3. Find the measure of a) ∡R
b) ∡T.



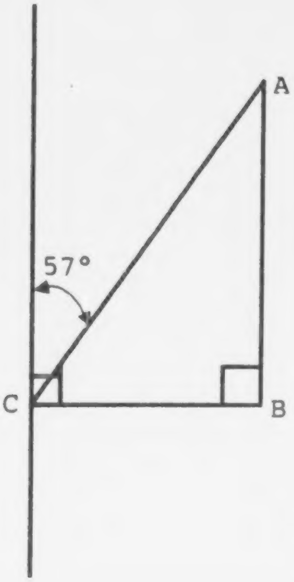
4. A surveyor has 3 property corners and he needs to know the angles that the property lines form. A stream running through the property is causing him a problem.

He sets his transit up at point A and determines that the angle at point A is 95°. He moves the transit to point B and determines the angle at point B to be 62°. He can now find the measure of the angle at point C. Find the measure of that angle.



5. Find the measure of a) ∡ACB

b) ∡A



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #53

Identify similar triangles and find the missing side.

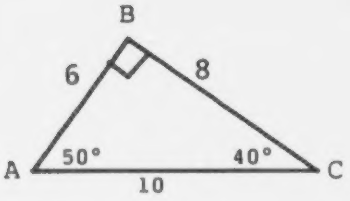
PERFORMANCE OBJECTIVE #72

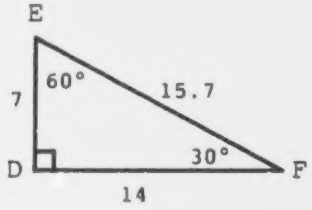
Given two triangles, tell whether or not they are similar.

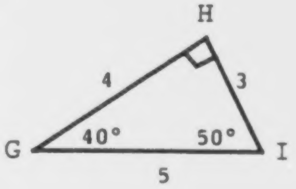
INSTRUCTIONAL ACTIVITIES

Sample Item

1. Of the following triangles, which ones are similar?







Solution:

In order to have similar triangles 2 specifications must both be met:

1) All corresponding angles must be of equal measure.

2) Corresponding sides must be proportionally equal.

a) Δ ABC and Δ EDF

∡B corresponds to ∡D and both are 90°

∡C corresponds to ∡F, ∡C is 40°, ∡F is 30°, they are not of equal measure; therefore, Δ ABC is not similar to Δ EDF.

b) Δ FDE and Δ GHI

∡D corresponds to ∡H and both are 90°.

∡F corresponds to ∡G, ∡F is 30°, ∡G is 40°, they are not of equal measure; therefore, Δ FDE is not similar to Δ GHI.

c) Δ ABC and Δ IHG

$\measuredangle A$ corresponds to $\measuredangle I$ and both are 50°.

$\measuredangle B$ corresponds to $\measuredangle H$ and both are 90°.

$\measuredangle C$ corresponds to $\measuredangle G$ and both are 40°.

All corresponding angles have equal measures.
AB corresponds to IH and has a ratio of 6/3 = 2/1.
BC corresponds to GH and has a ratio of 8/4 = 2/1.
AC corresponds to GI and has a ratio of 10/5 = 2/1.

All three pairs of corresponding sides are proportionally equal.

Both specifications are met; therefore, Δ ABC is similar to Δ IHG, written using symbols as $\Delta ABC \sim \Delta IHG$.

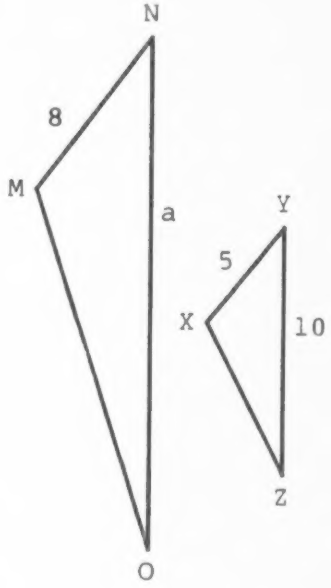
2. Find the missing side of the following similar triangles.

a) Set up a proportion for corresponding sides.

$$\frac{\text{large } \Delta}{\text{small } \Delta} = \frac{\text{large } \Delta}{\text{small } \Delta}$$

b) Substitute segments.

$$\frac{MN}{XY} = \frac{NO}{YZ}$$



c) Substitute the length of the sides.

$$\frac{8}{5} = \frac{a}{10}$$

d) Solve the proportion.

$$\frac{8}{5} = \frac{a}{10}$$

$80 = 5a$ cross multiply

$16 = a$ divide both sides by 5

The length of side NO is 16.

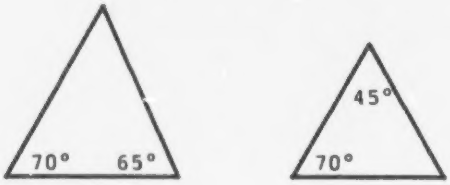
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 178-181.

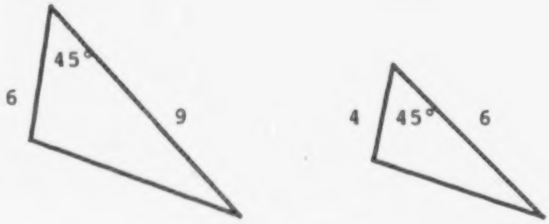
EVALUATION

Tell whether or not each pair of triangles is similar.

1.



2.



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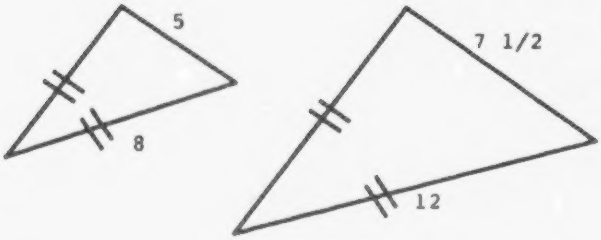

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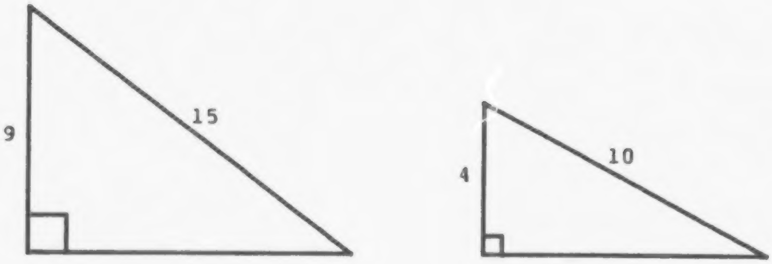


ANSWERS TO EVALUATION

1. Yes
2. Yes
3. Yes
4. No

ANSWERS TO APPLICATIONS

1. a) Yes
   b) 4.7
2. a) 7.5
   b) 4.5
   c) 40
3. 4.5
4. 200 feet
5. a) 6
   b) 15

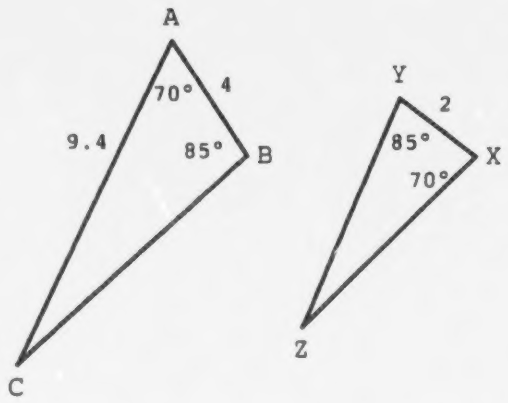
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #72

Performance Objective #72: Given two triangles, tell whether or not they are similar.

1. In the adjoining figures:

   a) Are the triangles similar?

   b) How long is $\overline{XZ}$?

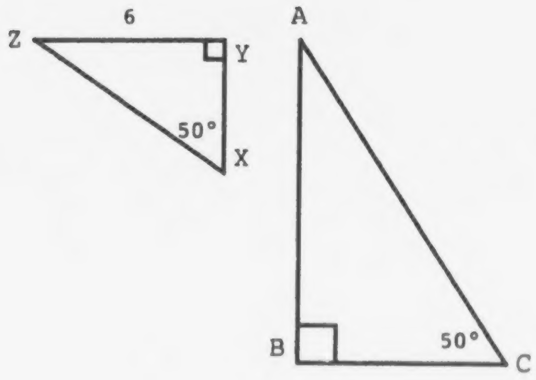


2. In the adjoining figures:

   a) How long is $\overline{XZ}$?

   b) How long is $\overline{YX}$?

   c) $m\measuredangle Z$?



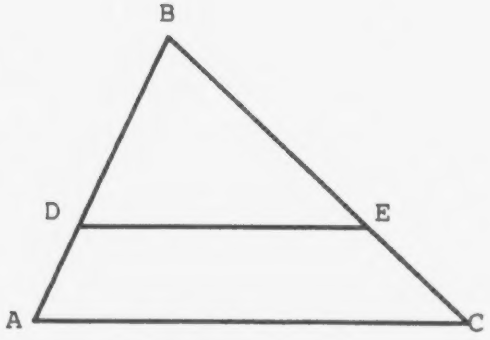
3. $\Delta BAC \sim \Delta BDE$

   $\overline{AB} = 8$

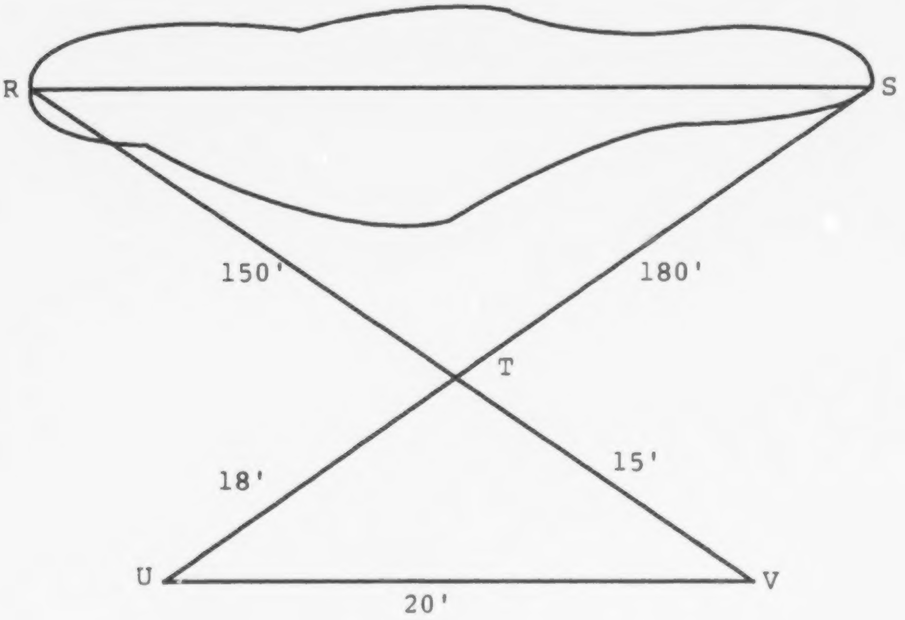
   $\overline{AD} = 3$

   $\overline{BC} = 12$

   $\overline{EC} = ?$

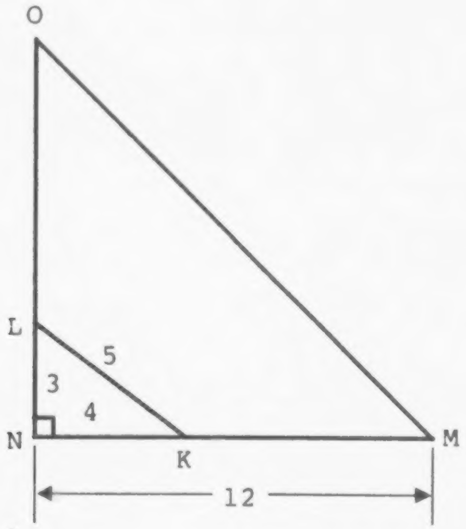


4. In order to find the distance across the pond, Mike drove stakes at R and S. He drove a stake at T, 150 ft. from R. He then measured 15 ft. more in the same direction as RT and drove a stake at V. Mike then found the distance ST to be 180 ft. Measuring another 18 ft. in the same direction as ST, he drove a stake at U. By using a tape measure Mike found the distance UV to be 20 ft. Find the distance across the pond.



5. a) Find the length of LO.

b) Find the length of MO.



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COMPETENCY #53

Identify similar triangles and find the missing side.

PERFORMANCE OBJECTIVE #73

Given two similar triangles and the ratio of the lengths of the sides, find the length of the missing side.

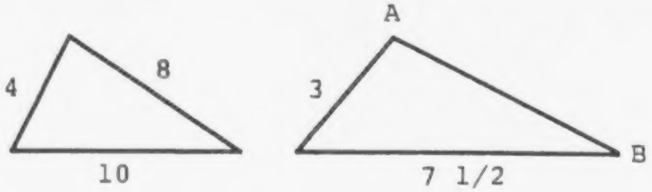
INSTRUCTIONAL ACTIVITIES

Sample Item

Given these similar triangles, find side AB.

$\frac{4}{8} = \frac{3}{?}$

(ans: AB = 6)



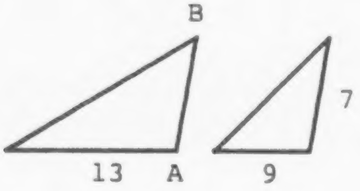
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 180-181.

EVALUATION

In each pair of similar triangles, find side AB.

1.



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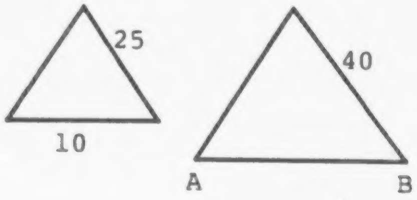

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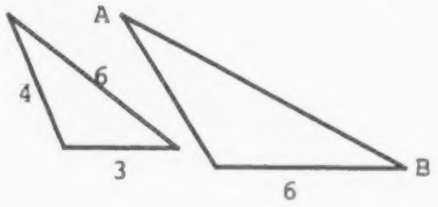

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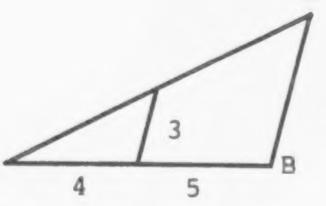


ANSWERS TO EVALUATION

1. 10.1
2. 16
3. 12
4. 6.75

ANSWERS TO APPLICATIONS

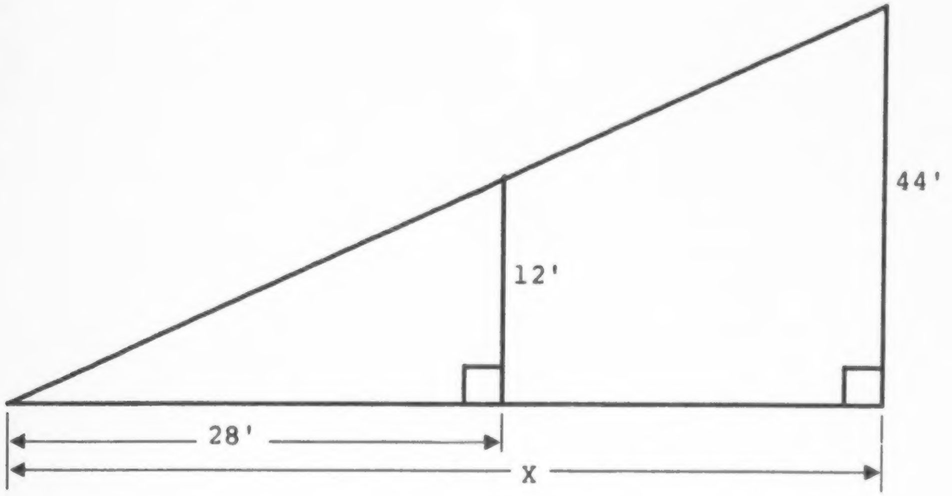
1. 102.67'
2. 48.45 m
3. 67.69 m

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #73

Performance Objective #73: Given two similar triangles and the ratio of the length of the sides, find the length of the missing side.

Given the following pairs of similar triangles, find the length of either x or y.

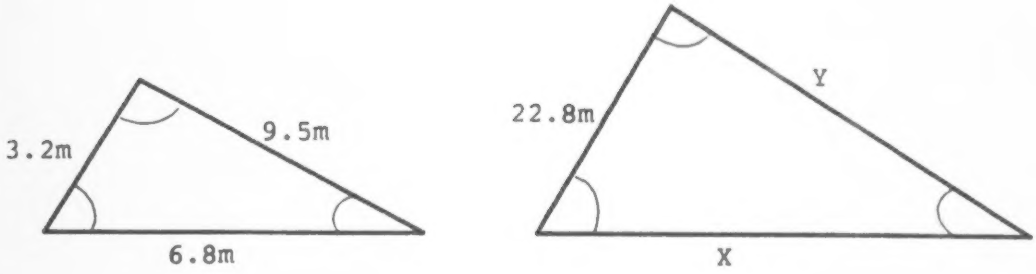
1. x = ?



Using the triangles below, find x and y.

2. x = ?

3. y = ?



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COMPETENCY #54

Read trigonometric tables.

PERFORMANCE OBJECTIVE #74

Given a table of trigonometric values, answer questions pertaining to the table.

INSTRUCTIONAL ACTIVITIES

Sample Item

Angle	sin	cos	tan
0°	.0000	1.0000	.0000
1°	.0175	.9998	.0175
2°	.0349	.9994	.0349
4°	.0698	.9976	.0699
5°	.0872	.9962	.0875

Given the above, find the values for each:

1. sin 4° = .0698
2. tan 2° = .0349
3. cos 1° = .9998

Notes

Most values of the trigonometric functions are irrational numbers; that is, the values are infinite, non-repeating decimals. Tables of decimal approximations can be found in any trigonometric text.

REFERENCE TO TEXT

None

EVALUATION

1. As angle measures increase, does the sine ratio increase or decrease?

2. Find these values from a trig table.

   a) sine 31°
   b) cos 42° 10'
   c) tan 45°

ANSWERS TO EVALUATION

1. increase

2. a) 0.51504
   b) 0.74118
   c) 1.000

ANSWERS TO APPLICATIONS

1. .3640

2. .8660

3. 1.0000

4. 2.748

5. .0000

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #74

Performance Objective #74: Given a table of trigonometric values, answer questions pertaining to the table.

1. tan 20°
2. sin 60°
3. cos 0°
4. tan 70°
5. cos 90°

COMPETENCY #55

Use sine, cosine and tangent functions.

PERFORMANCE OBJECTIVE #75

Given a right triangle, write the sine, cosine and tangent ratios.

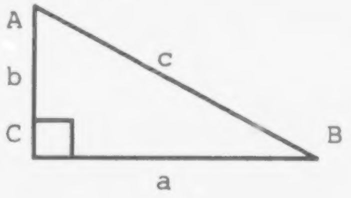
INSTRUCTIONAL ACTIVITIES

Sample Item

The ratios of sides of the right triangle are related to the acute angles as follows:

1. The ratio of the side opposite an acute angle to the adjacent side is called the tangent of the angle (abbreviated tan).
2. The ratio of the side opposite an acute angle to the hypotenuse is called the sine of the angle (abbreviated sin).
3. The ratio of the adjacent side of an acute angle to the hypotenuse is called the cosine of the angle (abbreviated cos).

In the right triangle ABC, $\tan A = a/b$ and $\tan B = b/a$. The $\sin A = a/c$ and $\sin B = b/c$. Also, the $\cos A = b/c$ and the $\cos B = a/c$.



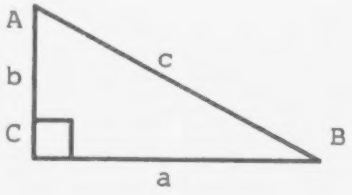
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 283-307, 390.

EVALUATION

Using this right triangle, write these ratios.

1. $\tan \angle A$
2. $\cos \angle B$
3. $\sin \angle B$
4. $\cos \angle A$



ANSWERS TO EVALUATION

1. a/b
2. a/c
3. b/c
4. b/c

ANSWERS TO APPLICATIONS

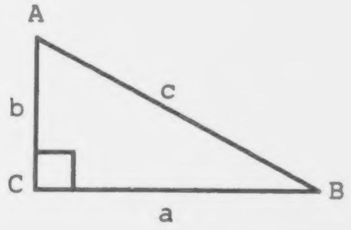
1. a/c
2. b/c
3. b/c
4. a/c
5. a/b
6. b/a

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #75

Performance Objective #75: Given a right triangle, write the sine, cosine and tangent ratios.

Use the given right triangle to state the ratios for each question.

1. sin A
2. cos A
3. sin B
4. cos B
5. tan A
6. tan B



COMPETENCY #55

Use sine, cosine and tangent functions.

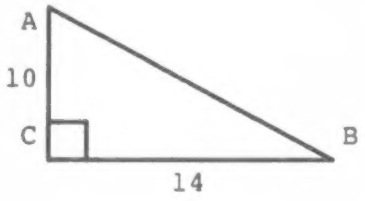
PERFORMANCE OBJECTIVE #76

Given right triangles, use the sine, cosine and tangent functions to find missing sides and angles.

INSTRUCTIONAL ACTIVITIES

Sample Item

Find the measure of angle B.



(ans: 35.5°)

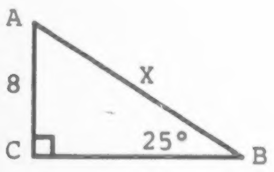
REFERENCE TO TEXT

None

EVALUATION

Find the indicated side or angle. (Round to nearest tenth.)

1.



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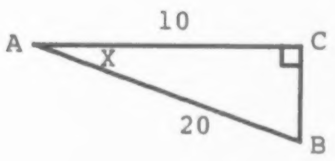

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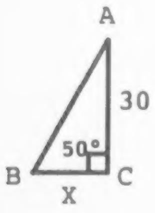

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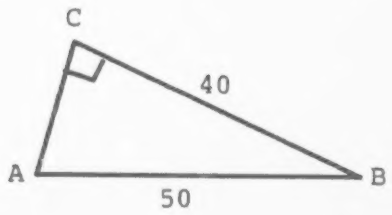


ANSWERS TO EVALUATION

1. 18.9
2. 60°
3. 25.2
4. 53.1°

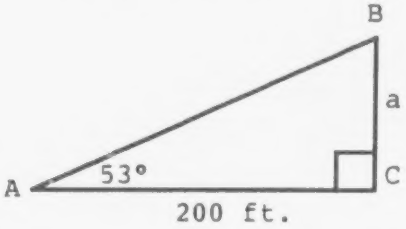
ANSWERS TO APPLICATIONS

1. 265.4 ft.
2. 9 ft.
3. 20°
4. 19° 34' or 19.6°
5. 4.720"
6. 19° 35' or 19°.6

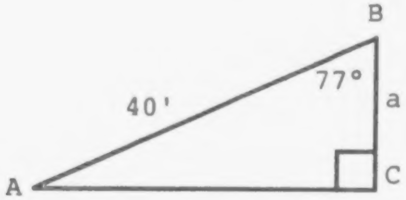
APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #76

Performance Objective #76: Given right triangles, use the sine, cosine and tangent functions to find missing sides and angles.

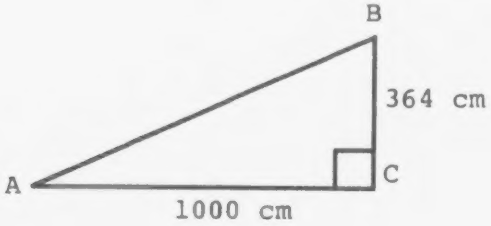
1. In right triangle ABC find side a when angle A = 53° and side b = 200 ft. (Round to tenths.)



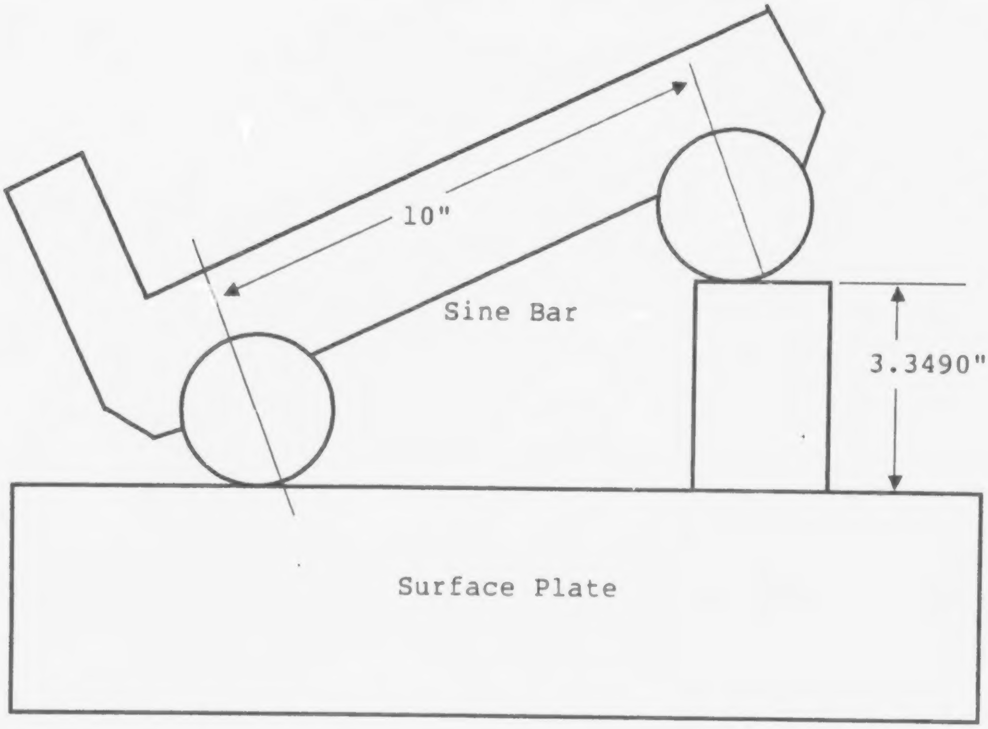
2. In right triangle ABC, find side a when Angle B = 77° and side c = 40 feet. (Round to tenths.)



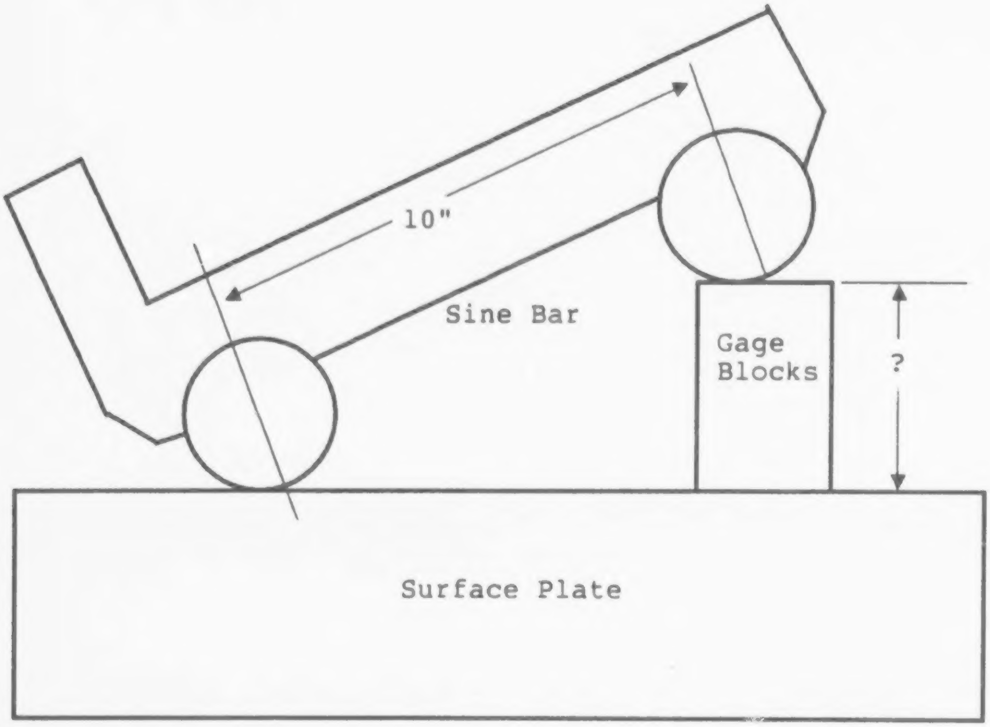
3. In right triangle ABC, find angle A to the nearest degree if side a = 364 cm and side b = 1,000 cm. (Round to tenths.)



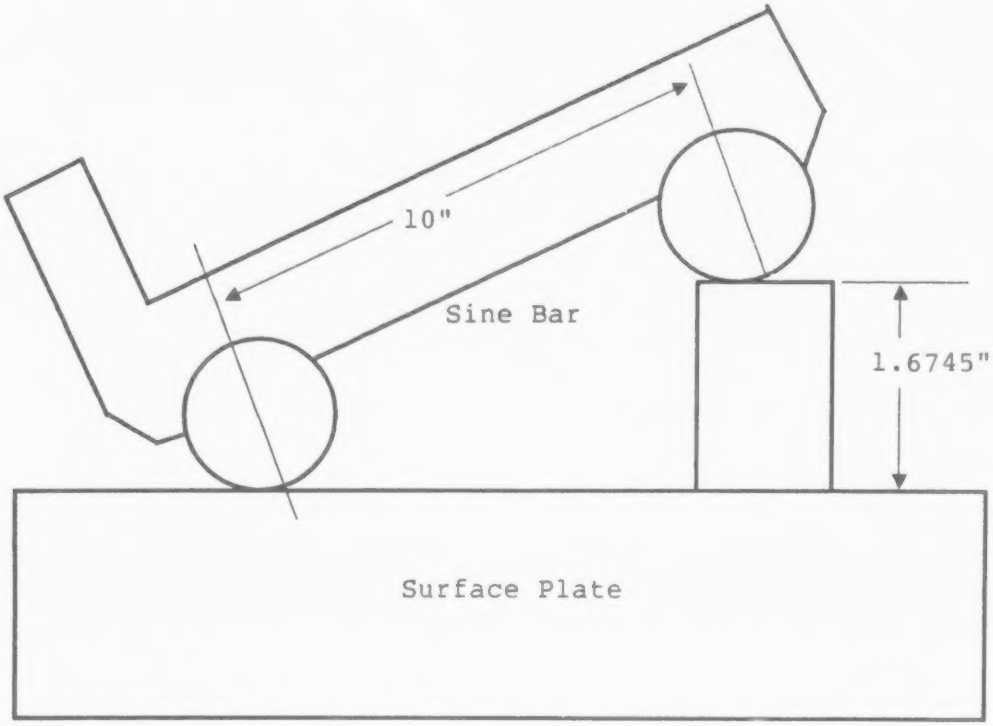
4. Given a trig table and the height of gage blocks, determine the angle between the surface plate and the sine bar.


10"
Sine Bar
3.3490"
Surface Plate

5. Given a 10" sine bar, surface plate and gage blocks, and with the use of Trig tables, determine the proper "stacking" of gage blocks to set the sine bar at 28° 10' with the surface plate.


10"
Sine Bar
Gage Blocks
?
Surface Plate

6. Given a trig table and the height of gage blocks, determine the angle between the surface plate and the sine bar.


10"
Sine Bar
1.6745"
Surface Plate

COMPETENCY #56

Identify quadrilaterals.

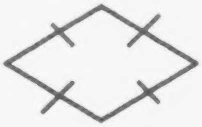
PERFORMANCE OBJECTIVE #77

Given a set of quadrilaterals, identify each as a parallelogram, square, rectangle, rhombus or trapezoid.

INSTRUCTIONAL ACTIVITIES

Sample Item

Identify this quadrilateral.



(ans: This quadrilateral is a rhombus. The opposite sides are parallel and all sides are equal in length while the angles are not right angles.)

Notes

A polygon with four sides is called a **quadrilateral.** Quadrilaterals can be classified by their sides and their relation to each other and by their angles.

A quadrilateral whose pairs of opposite sides are parallel is called a **PARALLELOGRAM.** The opposite sides have equal lengths and the opposite angles have equal measures.

A parallelogram with all right angles is called a **RECTANGLE.** Opposite sides are parallel and of equal lengths.

A rectangle whose four sides are all equal in length is called a **SQUARE.** Opposite sides are parallel and all angles are right angles.

A parallelogram whose four sides are all equal in length is called a **RHOMBUS.** Opposite sides are parallel, but the angles are not necessarily right angles.

A quadrilateral with only one pair of parallel sides is called a **TRAPEZOID.**

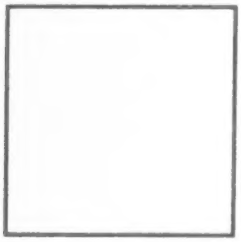
REFERENCE TO TEXT

None

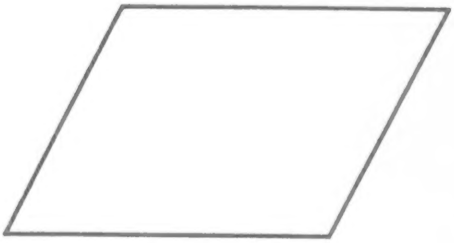
EVALUATION

Identify each quadrilateral.

1.



2.



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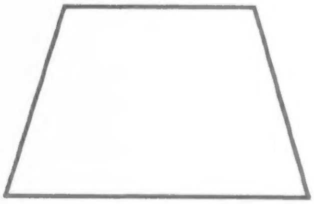
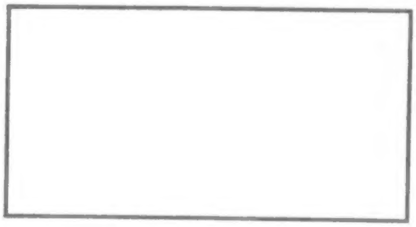


4.



ANSWERS TO EVALUATION

1. Square (also rectangle and parallelogram)
2. Parallelogram
3. Trapezoid
4. Rectangle (also parallelogram)

ANSWERS TO APPLICATIONS

A. 1. Rectangle
   Parallelogram
  2. Trapezoid
  3. Rhombus
   Parallelogram
  4. Parallelogram
  5. Square
   Rhombus
   Rectangle
  6. a) Parallelogram
   Proof: Opposite angles are congruent.
   Opposite sides are congruent.
   Pairs of adjacent angles are supplementary.
   b) Square
   Proof: All angles are 90°.
   All sides are equal in length (congruent).
   c) Trapezoid
   Proof: Only one pair of parallel sides exists.
  7. Instructor will examine drawings.
  8. a) True
   b) False
   c) True
   d) False
   e) False

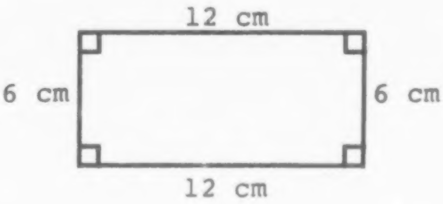
B. 1. Rhombus
  2. Parallelogram
  3. Square
  4. Rectangle
  5. Trapezoid
  6. All
  7. All
  8. Some
  9. Some
  10. All
  11. No
  12. Some
  13. All
  14. No
  15. No

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #77

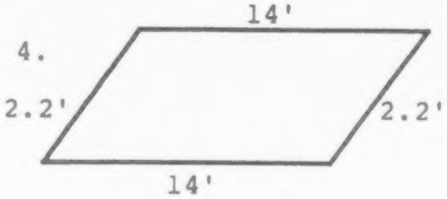
Performance Objective #77: Given a set of quadrilaterals, identify each as a parallelogram, square, rectangle, rhombus or trapezoid.

Identify the following quadrilaterals as a parallelogram, square, rectangle, rhombus or trapezoid.

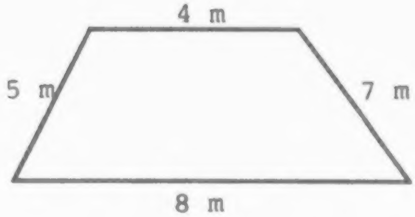
1.


12 cm
6 cm
6 cm
12 cm

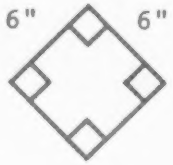
4.



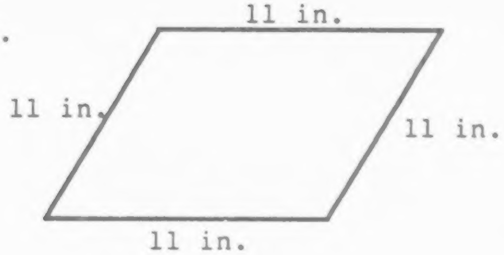
2.



5.

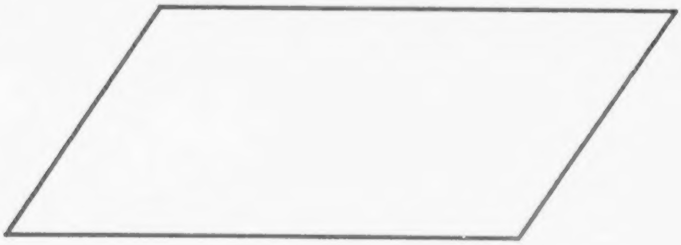


3.

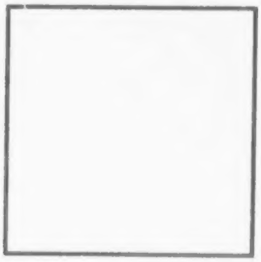

11 in.
11 in.
11 in.
11 in.

6. Based on knowledge about quadrilaterals, measure the angles in the figures below and identify each as parallelogram, square, rectangle, rhombus or trapezoid. Give proof.

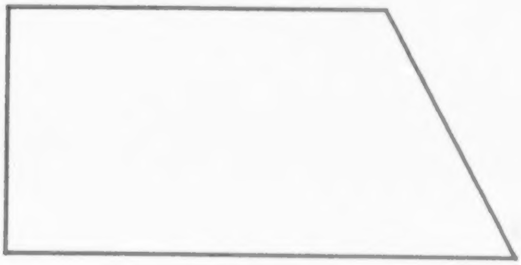
a)



b)



c)



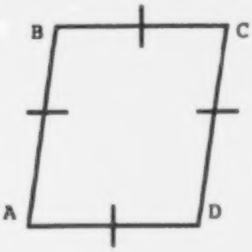
7. Draw one each: a square, a rectangle, a parallelogram, a rhombus, and a trapezoid. Identify each quadrilateral and state the properties of each.

8. Answer true or false.

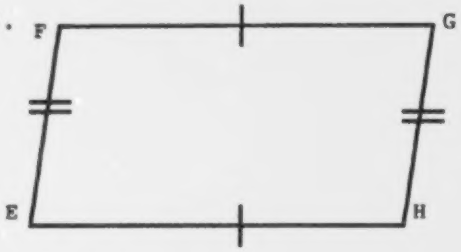
a) A square is a rectangle.
b) A rhombus is a square.
c) Some rhombi are rectangles.
d) A trapezoid is a parallelogram.
e) A parallelogram is a trapezoid.

B. Identify the type of quadrilateral shown.

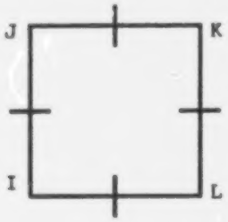
1.



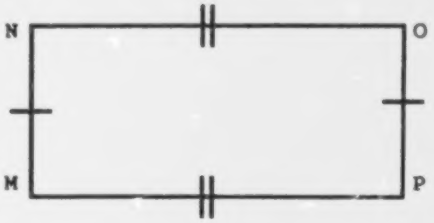
2.



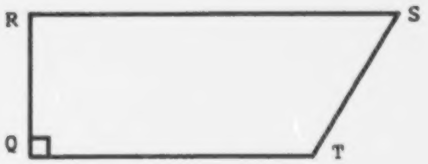
3.



4.



3.



Using the words some, all, or none, replace the blank with the word that best describes the relationship.

6. __________ rhombi are parallelograms.

7. __________ rectangles are quadrilaterals.

8. __________ rhombi are squares.

9. __________ rectangles are squares.

10. __________ squares are parallelograms.

11. __________ parallelograms are trapezoids.

12. __________ quadrilaterals are trapezoids.

13. __________ squares are rectangles.

14. __________ trapezoids are parallelograms.

15. __________ rectangles are trapezoids.

COMPETENCY #57

Identify the parts of a circle and tell the characteristics.

PERFORMANCE OBJECTIVE #78

Given a circle, identify radius, diameter, chords, arcs, central angle and inscribed angle.

INSTRUCTIONAL ACTIVITIES

Sample Item

1. Identify each of the following:

   a) O

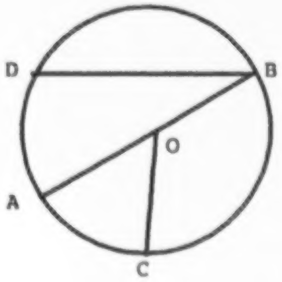
   b) $\overline{OC}$

   c) $\overline{AB}$

   d) $\angle AOC$

   e) $\angle DBA$

   f) $\overline{DB}$



ans: O is the center because it is the given point.

$\overline{OC}$ is a radius because it joins the center and a point on the circle.

$\overline{AB}$ is a diameter because it is a chord that contains the center of the circle.

$\angle AOC$ is a central angle because it has the center of the circle as its vertex.

$\angle DBA$ is an inscribed angle because its vertex lies on the circle and its sides are chords of the circle.

$\overline{DB}$ is a chord because its endpoints are on the circle.

2. If the radius of a circle is 12mm, find the circumference.

(ans: 75.36) A diameter is twice a radius. Since the radius is 12mm, the diameter is 24mm.

Using the formula $C = \Pi d$, and giving Π a rounded value of 3.14:

$C = 3.14 \times 24$
$C = 75.36$

Notes

A circle is the set of all points in a plane that are a given distance from a given point in the plane. The given point is the **CENTER** of the circle.

The **CIRCUMFERENCE** of a circle is the distance around the circle. The circumference is computed by the formula $C = \Pi d$ or $C = 2\Pi r$.

A **RADIUS** of a circle is a segment that joins the center and a point on the circle.

A **CHORD** is a segment whose endpoints lie on the circle.

A **DIAMETER** is a chord that contains the center of the circle.

An **ARC** is part of the circle.

A **CENTRAL ANGLE** of a circle is an angle whose vertex is the center of the circle.

An **INSCRIBED ANGLE** is an angle whose vertex lies on a circle and whose sides contain chords of the circle.

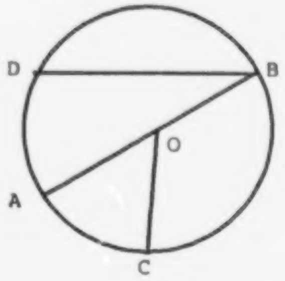
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 172-177.

EVALUATION

Identify each of the following.

1. $\overline{DB}$
2. $\overline{AB}$
3. $\overline{OB}$
4. $\angle AOC$



ANSWERS TO EVALUATION

1. Chord
2. Diameter
3. Radius
4. Central angle

ANSWERS TO APPLICATIONS

A. 1. Radius: $\overline{MN}$

Diameter: $\overline{LN}$

Chord: $\overline{XY}$
Arcs: 1-2 or 3-4 are possibilities

2. Small diameter: B

Large Diameter: A

Arcs: 1-3; 2-4

3. a) Radius
b) Diameter
c) Chord
d) Semi-circle or Arc

4. a) $\overline{EF}$, $\overline{GH}$, $\overline{HI}$

b) $\overline{AB}$

c) $\overline{AB}$, $\overline{CD}$, $\overline{LN}$, $\overline{LM}$, $\overline{MN}$

d) $\overline{KJ}$, $\overline{CD}$, $\overline{LN}$, $\overline{MN}$, $\overline{LM}$ are possibilities.

e) $\angle GHI$

f) ΔLMN

5. $\overline{AB}$ = radius

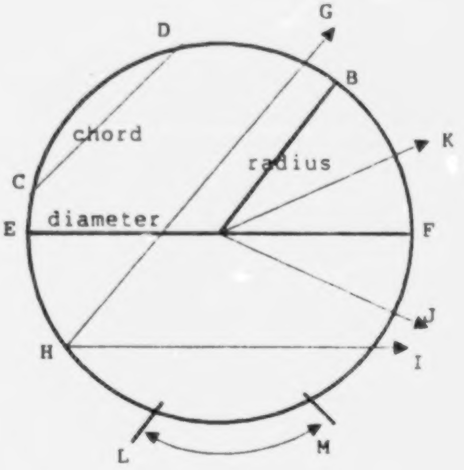
$\overline{CD}$ = chord

$\overline{EF}$ = diameter

$\angle GHI$ = inscribed angle

$\angle JAK$ = central angle

$\overline{LM}$ = arc



6. a) $\overline{AE}$, $\overline{AD}$, $\overline{BC}$, $\overline{BE}$

b) $\overline{BE}$, $\overline{AD}$

c) $\overline{AO}$, $\overline{BO}$, $\overline{CO}$, $\overline{DO}$, $\overline{EO}$

d) $\overline{AB}$, $\overline{BC}$, $\overline{CD}$, $\overline{DE}$, $\overline{EA}$ (Others possible also)

B. 1. Center

2. $\overline{OU}$, $\overline{OT}$, $\overline{OS}$, $\overline{OR}$, $\overline{OQ}$, $\overline{OP}$

3. $\overline{PT}$, $\overline{UR}$

4. 2

5. 1/2

6. 1/2

7. 2

8. $\angle POQ$ or $\angle POU$ (other possibilities)

9. $\angle VTP$

10. 13.188m

11. 21.98cm

12. 235.5mm

13. 0.1256m

14. 18.84m

15. 226.08km

16. 0.1256m

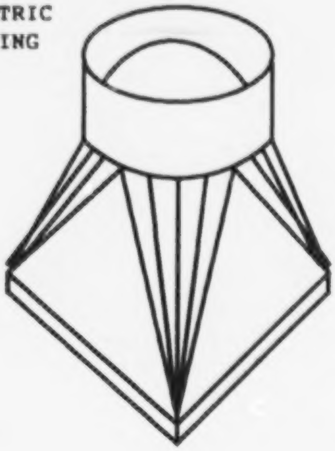
17. 26.376cm

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #78

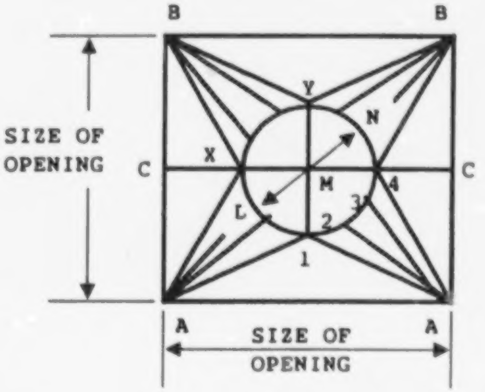
Performance Objective #78: Given a circle, identify radius, diameter, chords, arcs, central angle and inscribed angle.

A. 1. When making a square to round fitting, as shown in the isometric drawing, a top view would be developed as shown below. Identify the following: radius, diameter, chord, 2 arcs.

ISOMETRIC DRAWING

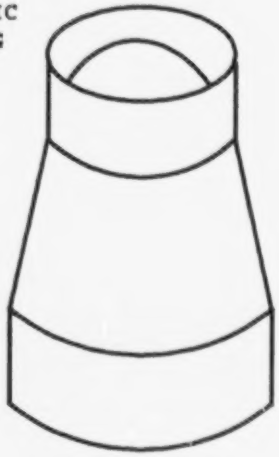


TOP VIEW

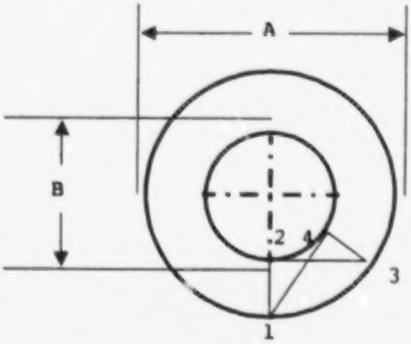


2. When making a round taper fitting as shown, a top view would be developed as shown below. Identify the following: small diameter, large diameter, 2 arcs.

ISOMETRIC DRAWING



TOP VIEW



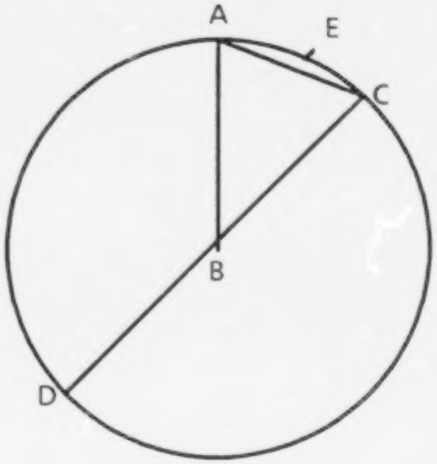
3. Identify:

a) $\overline{AB}$

b) $\overline{DC}$

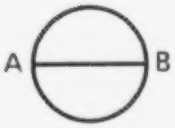
c) $\overline{AC}$

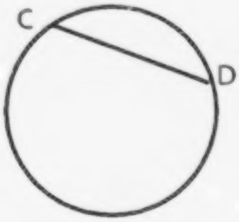
d) $\overline{DAC}$

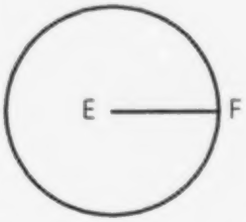


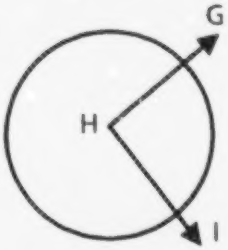
4. Use these figures to name these parts.

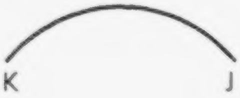
a) a radius
b) a diameter
c) a chord
d) an arc
e) a central angle
f) an inscribed triangle

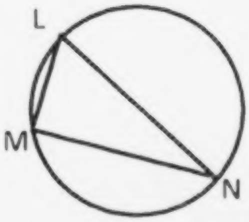






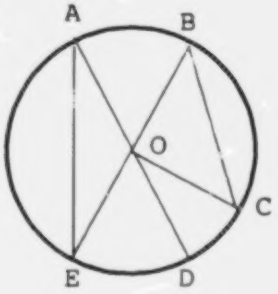






5. Draw a circle with a 2" diameter; show the radius, chord, arc, central angle, and inscribed angle.

6. The drawing below is a circle with several segments drawn inside of it. Answer the questions regarding the circle.



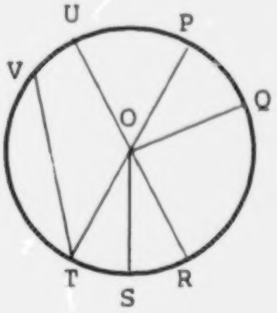
a) Name all the chords in the circle.

b) Name the diameters in the circle.

c) Name all the radii in the circle.

d) Name all the arcs (in order clockwise) in the circle.

B. Use the given circle for exercises 1 - 9.



1. O is the ______________________________ of the circle.

2. Name all the radii shown in the circle.

3. Name all the diameters shown in the circle.

4. $\overline{PT}$ is how many times as long as $\overline{PO}$?

5. $\overline{OR}$ is how many times as long as $\overline{RU}$?

6. $\overline{OS}$ is how many times as long as $\overline{PT}$?

7. $\overline{PT}$ is how many times as long as $\overline{OQ}$?

8. Name a central angle that has chord OP as one of its sides.

9. Name all inscribed angles.

Find the circumference of the circle. Use 3.14 for Π.

10. 4.2m

11. 7cm

12. 75mm

13. 0.04m

The radius measures:

14. 3m

15. 36km

16. 0.02m

17. 4.2cm

COMPETENCY #58

Find the circumference of a circle.

PERFORMANCE OBJECTIVE #79

Given a circle and the measure of its radius or diameter, find the circumference.

INSTRUCTIONAL ACTIVITIES

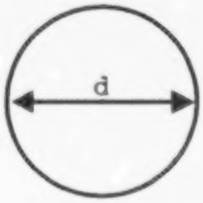
Sample Item

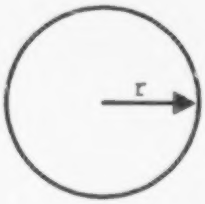
The perimeter of a circle is called the circumference. The circumference (C) is:

d = Diameter

$\Pi = 3.14$

r = Radius





$C = \Pi d$

$C = 3.14 \times 33''$

$C = 103.62''$

$C = 2\Pi r$

$C = 2 \times 3.14 \times r$

$C = 478.54\text{cm}$

Notes

Supply the students with about ten different circular objects. The student will measure the diameter and circumference of each item, then compute the ratio C/d. Have the students do the measures using both customary and metric units. Better precision is attained if a caliper is used to determine the diameter. This activity will lead the students to a better understanding of the value of pi (Π). Many circular objects (cylinders) are formed from flat pieces of material. Knowing how to determine the circumference of the circle is important in order to cut the pieces correctly for forming cylinders.

REFERENCE TO TEXT

CAREER MATHEMATICS, pages 172-177.

EVALUATION

1. How much molding is needed to go around a 48" diameter circular table? (Round to the nearest tenth?)

2. How much trim is needed to go around a 2m diameter circular table cloth?

3. How wide must insulation be cut to go around a 25cm diameter duct? Allow 3cm for overlap.

4. What is the circumference of a circle with a radius of 6 inches?

ANSWERS TO EVALUATION

1. 150.7"
2. 6.28 m
3. 81.5 cm
4. 37.68"

ANSWERS TO APPLICATIONS

A. 1. 492.98'
   2. 5 ft. 2.8"
   3. 89.176 cm
   4. a) 37.68"
      b) 28.26'
      c) 38.308 cm
   5. $A = \Pi d = 3.14 \times 6 = 18.84$"
      18.84" + 1.50" (seam allowance) = 20.34"

      Required: A piece of metal at least 4' x 20.34"

B. 1. 9.42'
   2. 56.52"
   3. 153.86 cm
   4. 56.52"
   5. 200.96 m
   6. 91.06 cm

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #79

Performance Objective #79: Given a circle and the measure of its radius or diameter, find the circumference.

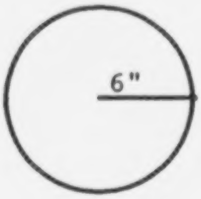
A. 1. What is the circumference of a circle with the radius equal to 78.5 feet?

2. What is the circumference in feet and inches of a circle with a radius of 10 inches?

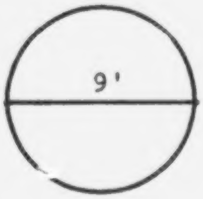
3. What is the circumference of a circle with a radius of 14.2 cm?

4. Find the circumference of the following circles. (Use 3.14 for Π.)

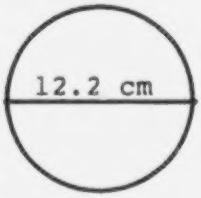
a)



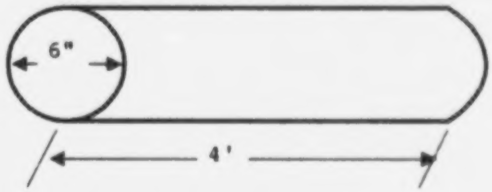
b)



c)



5. A round pipe or duct is to be made from a flat piece of metal. The pipe is to be 4' long and 6" in diameter. One and one half inches are allowed for the seam. What size piece of metal would be required?

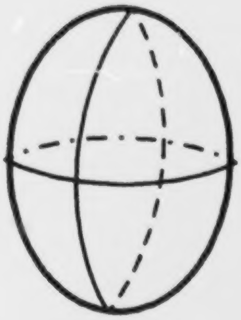


B. Given the measure of the radius or diameter, find the circumference.

1. Diameter = 3'
2. Diameter = 18"
3. Diameter = 49 cm
4. Radius = 9"
5. Radius = 32 m
6. Radius = 14.5 cm

section VIII

measurement - area and volume



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #59

Find the area of a triangle, parallelogram or circle.

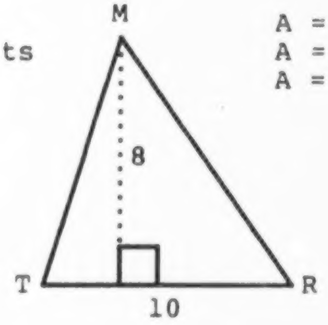
PERFORMANCE OBJECTIVE #80

Given a triangle, parallelogram or circle, and the necessary measurements, compute the area.

INSTRUCTIONAL ACTIVITIES

Sample Item

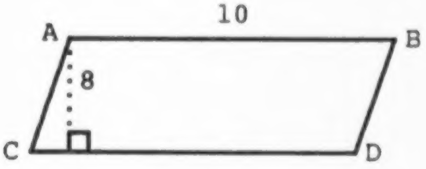
1. Find the area of ΔTMR.
   Length of base = 10 units
   Height = 8 units
   Area = 1/2b * h



A = 1/2(10 * 8)
A = 1/2(80)
A = 40 sq. units

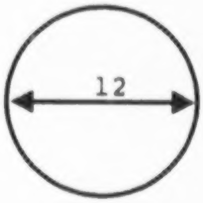
2. Find the area of parallelogram □ABCD.
   Length of base = 10 units
   Height = 8 units

Area = b * h
A = 10 * 8
A = 80 sq. units



3. Find the area of this circle.
   Use 3.14 for Π.
   Since d = 2r   r = 6
   Area = $\Pi * r^2$

A = Π * 6 * 6
A = 3.14 * 36
A = 113.04 sq. units



Notes

A parallelogram is a trapezoid with parallel lines of equal lengths.

Area of parallelogram = b * h. Area of a triangle = 1/2 b * h.

Area of circle = $\Pi * r^2$.

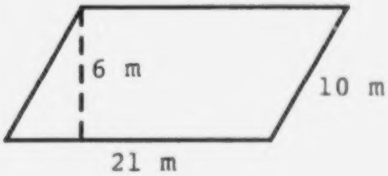
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 110-119.

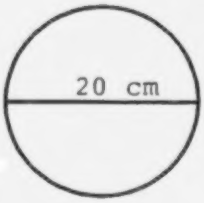
EVALUATION

Find the area.

1.



2.



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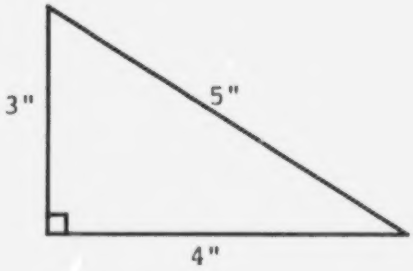

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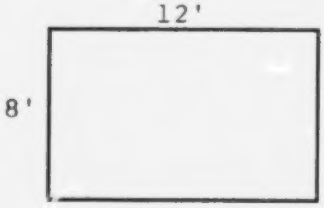


ANSWERS TO EVALUATION

1. 126 m^2
2. 314 cm^2
3. 6 sq. in.
4. 96 sq. ft.

ANSWERS TO APPLICATIONS

A. 1. 68.93 cm^2

2. 63 sq. ft.

3. 52.78 sq. in.

4. a) 78 sq. ft.
   b) 62 sq. yd. or 558 sq. ft.
   c) 32 sq. ft.
   d) 3 1/8 sq. in. (3.13)

5. a) 78.50 sq. in.
   b) 63.59 sq. in.
   c) 706.50 sq. ft.
   d) 200.96 sq. in.

6. a) 100 sq. in.
   b) 37 1/8 sq. in. (37.13)
   c) 82 1/2 sq. in. (82.50)
   d) 12 sq. ft.

B. 1. 44 sq. m

2. .8 sq. units

3. 66 sq. units

4. 23.7 sq. units

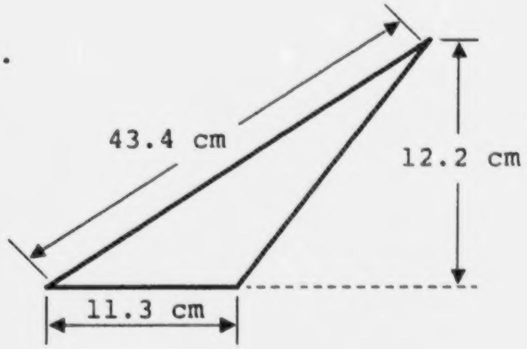
5. 102.0 sq. m

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #80

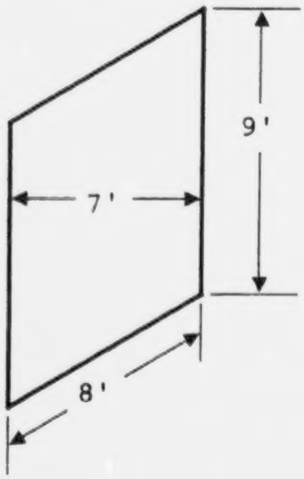
Performance Objective #80: Given a triangle, parallelogram or circle and the necessary measurements, compute the area.

Find the area of the following figures. Round answers to nearest hundredth.

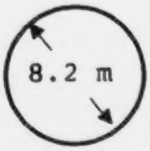
A 1.



2.



3.



4. Find the area of a parallelogram with base and height given.

$A = bh$

	Base	Height
a)	12 ft.	6 1/2 ft.
b)	31 yds.	6 ft.
c)	8 ft.	48 in.
d)	2 1/2 in.	1 1/4 in.

5. Find the area of a circle with the radius given.

$A = \Pi r^2$

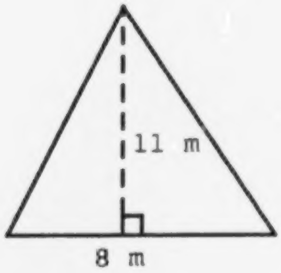
	Radius
a)	5 in.
b)	4 1/2 in.
c)	15 ft.
d)	8 in.

6. Find the area of a triangle with the base and height given.

$A = 1/2bh$

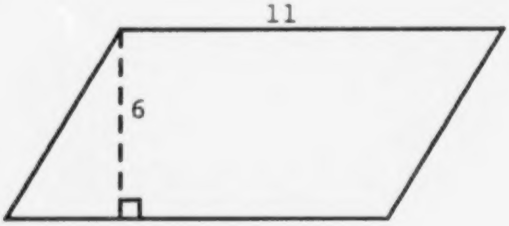
	Base	Height
a)	12.5 in.	16 in.
b)	8 1/4 in.	9 in.
c)	11 in.	15 in.
d)	4 ft.	6 ft.

B. 1. How much material was used to make the sail?

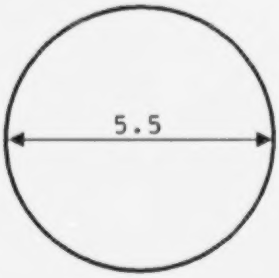


2. Find the area of a triangle with base = 8 units and height = .2 units.

3. Find the area of this figure.



4. Find the area of the circle. Round answer to the nearest tenth.



5. A dog is tied to a stake by a rope that is 5.7 meters long. What is the area of the ground available for it to play on? Round answer to the nearest tenth.

COMPETENCY #60

Find the area of irregular figures.

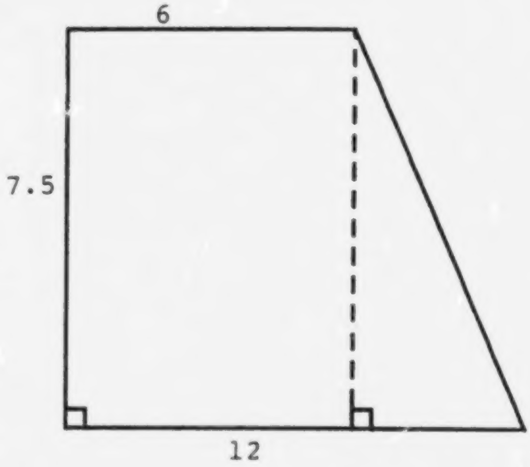
PERFORMANCE OBJECTIVE #81

Given an irregular polygon and the necessary measurements, subdivide the polygon and compute the area.

INSTRUCTIONAL ACTIVITIES

Sample Item

Find the area of the figure.
Area of rectangle = l * w
A = 6 * 7.5
A = 45



Area of triangle = 1/2b * h
A = 1/2 * 6 * 7.5
A = 1/2 (45)
A = 22.5

Area of figure = Area of rectangle + Area of triangle
A = 45 + 22.5
A = 67.5 sq. units

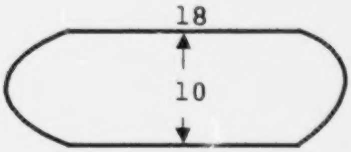
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 114-115, 119.

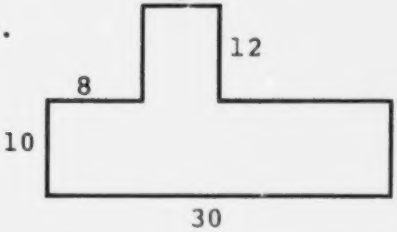
EVALUATION

Find the area.

1.



2.



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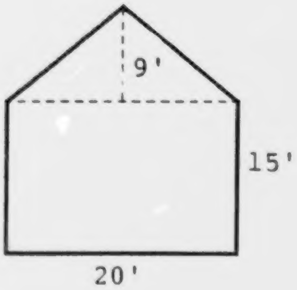

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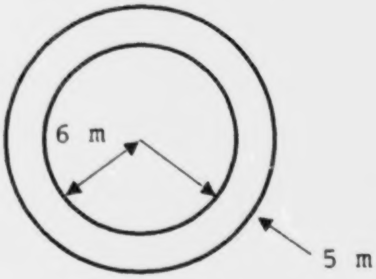


ANSWERS TO EVALUATION

1. 258.5 sq. units
2. 360 sq. units
3. 390 sq. ft.
4. 266.9 sq. m.

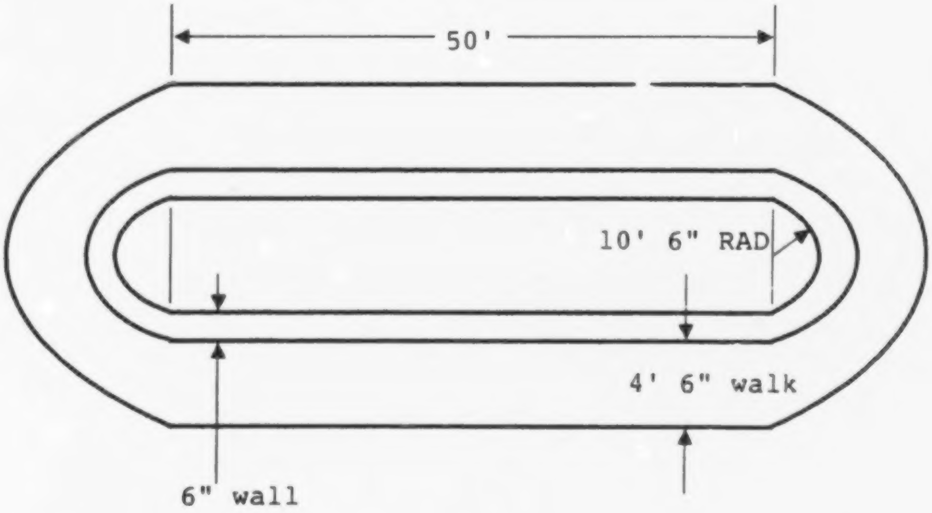
ANSWERS TO APPLICATIONS

A.
  1. 1396.185 sq. ft.
  2. 83.755 sq. ft.
  3. 824.445 sq. ft.

B.
  1. 77.9472 sq. ft.
  2. 60 sq. ft.
  3. 26 sq. ft.
  4. 156 sq. ft.

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #81

Performance Objective #81: Given an irregular polygon and the necessary measurements, subdivide the polygon and compute the area.



50'
10' 6" RAD
4' 6" walk
6" wall

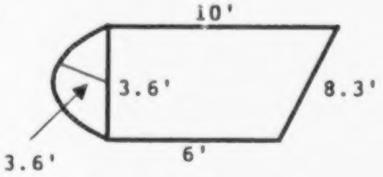
A. 1. What is the area of the inside of the flower bed?

2. What is the area of the top of the wall?

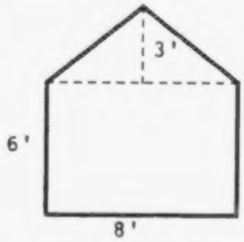
3. What is the area of the walk around the flower bed?

B. Find the area of the given figures.

1.



2.



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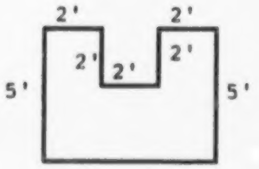
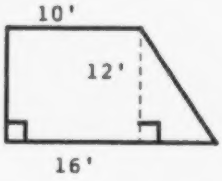


4.



COMPETENCY #61

Find the surface area of rectangular solids and cylinders.

PERFORMANCE OBJECTIVE #82

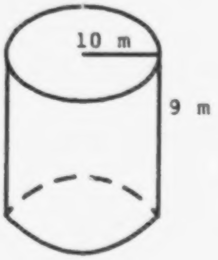
Given a rectangular solid or cylinder and the necessary measurements, find the surface area.

INSTRUCTIONAL ACTIVITIES

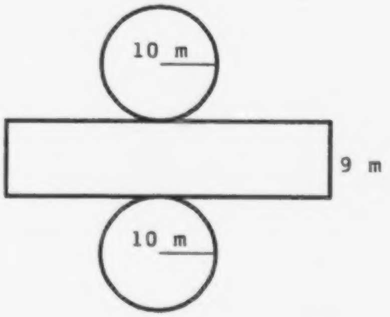
Sample Item

The surface area of a prism is the sum of the areas of its faces. The total surface area of a cylinder is a rectangle and two circles and the surface area of a rectangular solid is the sum of the surfaces or faces of the solid.

1. Find the surface area of this cylinder.



Solution: The flat diagram below shows the surface of the cylinder. The length of the rectangle is the circumference of the circle ($2\Pi r$). The width of the rectangle is the height of the cylinder.



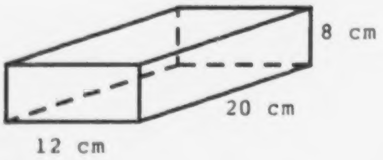
To find the surface area, add the area of the rectangle and the areas of the two circles. Use this formula.

$$\underset{\displaystyle A}{\underset{\downarrow}{\text{Surface Area}}} = \underset{\displaystyle (2\Pi r)h}{\underset{\downarrow}{\text{Area of Rectangle}}} + \underset{\displaystyle 2\Pi r^2}{\underset{\downarrow}{\text{Area of Two Circles}}}$$

$$A = 2(3.14)(10)(9) + 2(3.14)(10)^2$$
$$A = 2(3.14)(10)(9) + 2(3.14)(100)$$
$$A = 565.2 + 628$$
$$A = 1193.2$$

The surface area is about 1193.2 m^2

2. Find the surface area of this rectangular solid.



Solution: To find the surface area of a rectangular solid, add the areas of the six rectangular faces. Use this formula.

$$\underset{\text{Surface Area}}{\underset{\uparrow}{A}} = \underset{\text{Area of top and bottom}}{\underset{\uparrow}{2lw}} + \underset{\text{Area of two sides}}{\underset{\uparrow}{2lh}} + \underset{\text{Area of front and back}}{\underset{\uparrow}{2wh}}$$

$$A = 2lw + 2lh + 2wh$$
$$A = 2(20)(12) + 2(20)(8) + 2(12)(8)$$
$$A = 480 + 320 + 192$$
$$A = 992$$

The surface area is 992 cm^2

Notes

To help students see that the total surface area of a cylinder is a rectangle and two circles, cut an oatmeal box and lay it flat. This also helps the students see that one of the dimensions of the rectangle is the circumference of the base. Helping students visualize these solids and using area formulas they already know is usually an easier method than introducing new and more complicated formulas. When figuring sheet rock needed, find the area of solid walls. Disregard doors and windows.

Knowing the amount of material that is needed is imperative in determining the cost of objects.

REFERENCE TO TEXT

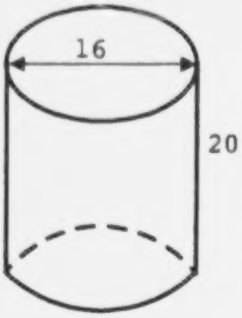
CAREER MATHEMATICS, pages 190-197.

EVALUATION

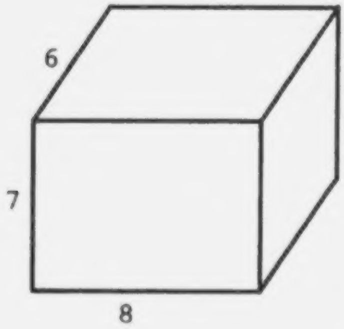
1. A cylindrical water tank is 150 feet tall and 60 feet in diameter. To determine the amount of paint needed, find the area of the sides and top.

2. A rectangle prism has a base 8' x 10' and height 20'. Find the total surface area.

3. Find the total surface area.



4. Find the total surface area.



ANSWERS TO EVALUATION

1. 31,086 sq. ft.
2. 880 sq. ft.
3. 1406.72 sq. units
4. 292 sq. units

ANSWERS TO APPLICATIONS

A. 1. a) 471 sq. in. c) 602.88 cm^2

b) 70.65 sq. in. d) 30,144 mm^2

2. 696 sq. ft.

3. 62.8 sq. ft.

4. H x L = 6" x 4' = 1/2' x 4' = 2 sq. ft.
H x L = 6" x 4' = 1/2' x 4' = 2 sq. ft.
W x L = 12" x 4' = 1' x 4' = 4 sq. ft.
W x L = 12" x 4' = 1' x 4' = 4 sq. ft.
12 sq. ft. x 2 = 24 sq. ft.

Repeat for each:

12" x 12" = 1' + 1' + 1' + 1' = 4' x 4' = 16' x 2 = 32 sq. ft.
12" x 18" = 1' + 1' + 1 1/2' + 1 1/2' x 4'
= 5' x 4' = 20' x 2 = 40 sq. ft.
96 sq. ft.

96 sq. ft. x 1.25 = 120 sq. ft. total

B. 1. 301.44 m^2

2. 981.25 sq. feet

3. 180 sq. inches

4. 392 sq. feet

5. 830.64 cm^2

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #82

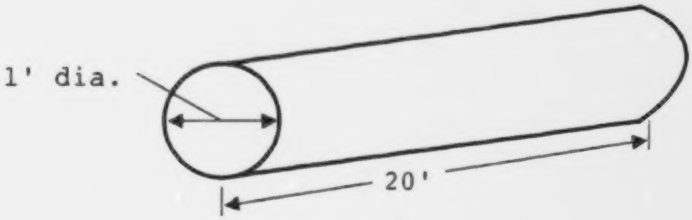
Performance Objective #82: Given a rectangular solid or cylinder and the necessary measurements, find the surface area.

A. 1. Determine the surface area of a cylinder with the radii and heights given.

a) r = 5"; h = 10"
b) r = 1.5"; h = 6"
c) r = 6 cm; h = 10 cm
d) r = 40 mm; h = 80 mm

2. Figure the number of square feet of sheetrock in the walls and ceiling of a room 12' by 18' with an 8' ceiling.

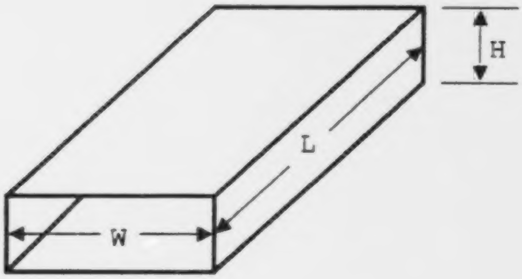
3. How many square feet of sheet metal will it take to make a 20' circular duct with 1' diameter?



4. Six pieces of metal duct are to be made for an air conditioning system. All six pieces will be 4 ft. long. The size of the duct will be as follows:

6" x 12" (2 each)
12" x 12" (2 each)
12" x 18" (2 each)

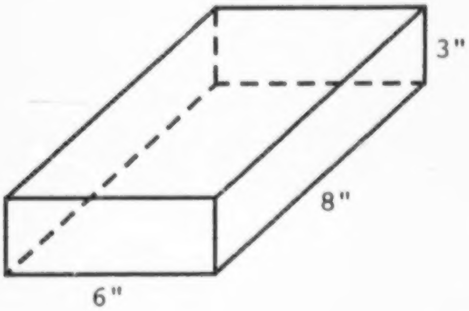
An extra 25% must be added for waste when cutting. How many square feet of metal is needed?



B. 1. A cylindrical water tank is 10 m tall and has a radius of 4 m. To determine the amount of paint needed, find the area of the sides and top.

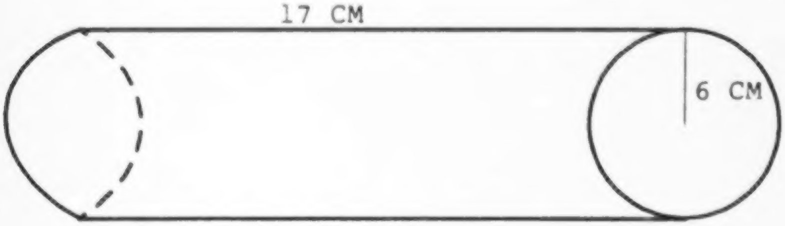
2. How many square feet of sheet metal will it take to make a 25' circular duct with 5' radius? (Allow 25% for waste.)

3. Find the surface area of the rectangular box shown. Dimensions are in inches.



4. Find the number of square feet of sheetrock in the walls and ceiling of a room 7' by 14' with a 7' ceiling.

5. Find the total surface area of the right circular cylinder shown. Dimensions are in centimeters.



414

COMPETENCY #62

Find the volume of rectangular solids and cylinders.

PERFORMANCE OBJECTIVE #83

Given a rectangular solid or cylinder and one necessary measurement, find the volume.

INSTRUCTIONAL ACTIVITIES

Sample Item

Remember that B in a formula means to find the area of the base.

1. Find the volume of a cylinder with a base of 30 square centimeters and an altitude of 6 centimeters.

   Solution: $V = Bh$ $V = 30\ cm^2 \times 6\ cm = 180\ cm^3$

2. A cylindrical tank has a 6-foot diameter and a height of 5.5 feet. Find its volume.

   Solution: Since the B is not given, the second form of the formula should be used.

   $A = 3.14(3\ ft)^2(5.5\ ft) = 155.43$ cu. ft.

3. Compute the volume of a rectangular solid whose base area is 15 square inches and whose altitude is 6 inches.

   Solution: $V = Bh$ $V = 15$ sq. in. x 6 in. = 90 cu. in.

4. Compute the volume of a rectangular solid whose dimensions are: length 8.2 m, width 6.2 m, height 1.4 m.

   Solution: $8.2\ m \times 6.2\ m \times 1.4\ m = 71.176\ m^3$

Notes

The following information is supplied to enable the student to work the problems involving finding the volume of a rectangular solid or a cylinder:

1. Since the volume of a figure refers to the amount of space inside the rectangular solid or cylinder, we shall be dealing with cubic units.

2. The formula for the volume of a rectangular solid is:

$V = lwh$ where V = volume
l = length
w = width
h = height or altitude

or

$V = Bh$ where V = volume
B = area of the base
h = height or altitude

3. The formula for the volume of a cylinder is:

$V = Bh$ where V = volume
B = area of the base
h = height or altitude

or

$V = \Pi r^2 h$ where V = volume
r = radius of the base
h = height or altitude

(This form is used when one does not know the area of the base. Since the base is a circle the area of a circle, Πr^2, may be substituted for B.)

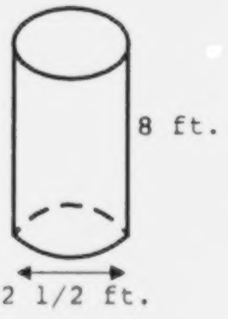
REFERENCE TO TEXT

CAREER MATHEMATICS, pages 191-201.

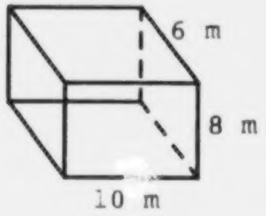
EVALUATION

Find the volume.

1.



2.



3. A cube 3 ft. to a side.

4. A room 8 ft. x 10 ft. x 12 ft.

ANSWERS TO EVALUATION

1. 39.25 cubic ft.
2. 480 m^3
3. 27 cu. ft.
4. 960 cu. ft.

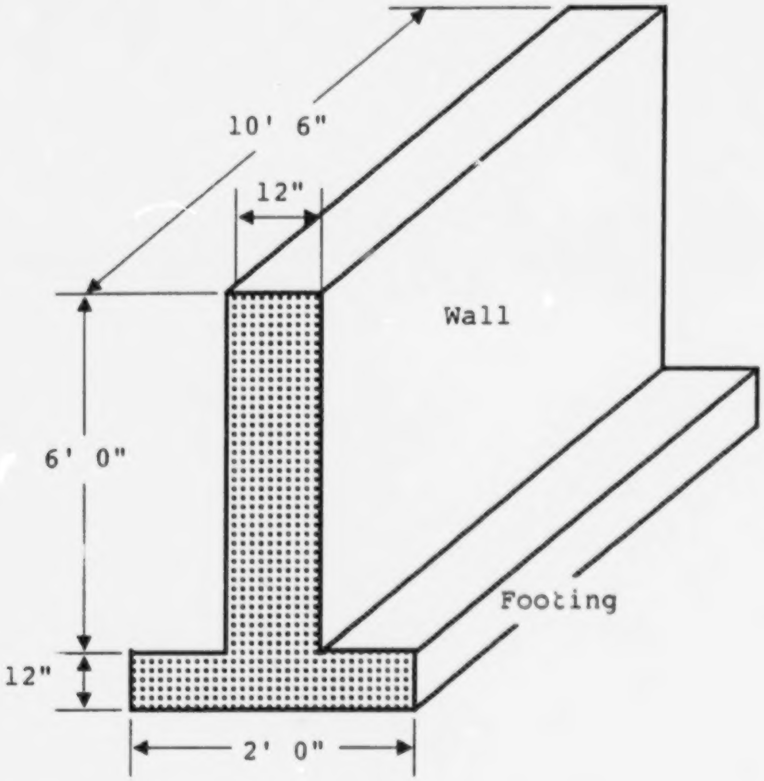
ANSWERS TO APPLICATIONS

A. 1. 21 cu. ft.
  2. 63 cu. ft.
  3. Need 3.111 cu. yds.
  4. 72 cu. ft.
  5. 8 cu. ft.
  6. a) 648 cu. yds.
    b) 5.47 cu. ft.
    c) 71 3/4 cu. in.
    d) 47.19 cm^3
    e) 33.75 cu. yds.

B. 1. 1000 cu. in.
  2. 12.6 m^3
  3. 1088.89 cu. yds.
  4. 15 cu. yds. 55,500 pounds
  5. 653.6 cu. in.
  6. 682.94 cm^3
  7. .35 m^3
  8. 275.37 cm^3
  9. 225.72 cu. in.

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #83

Performance Objective #83: Given a rectangular solid or cylinder and one necessary measurement, find the volume.



A. 1. How many cubic feet of concrete does the footing contain?

2. How many cubic feet of concrete does the foundation wall contain?

3. How many cubic yards of concrete should be ordered to pour both the footing and the foundation wall?

4. A cooling tower has a tank that is 12 ft. long, 12 in. high and 6 ft. wide. What is the volume of the tank in cubic feet?

5. A concrete pad is to be poured to support a condensing unit. The pad is 6 ft. x 4 ft. x 4 in. How many cubic feet of concrete will be required?

6. Find the volume of a rectangular solid with length, width and height given. (Round to hundredths.)

	Length	Width	Height
a)	27 yds.	12 yds.	2 yds.
b)	2.5 ft.	1.75 ft.	1.25 ft.
c)	10 1/4 in.	3 1/2 in.	2 in.
d)	5.5 cm	3.9 cm	2.2 cm
e)	6 yds.	4.5 yds.	1.25 yds.

B. 1. Find the volume of a rectangular solid whose base area is 125 square inches and whose height is 8 inches.

2. Compute the volume of a wall which is 0.9 m thick, 7 m long, and 2 m high.

3. An excavation for a building foundation is 60 feet long, 35 feet wide, and 14 feet deep. How many cubic yards of soil are removed? (HINT: 1 cu. yd. = 27 cu. ft.)

4. A concrete slab is 40.5 feet long, 20 feet wide, and 0.5 feet high. Find the volume of the slab in cubic yards and then find the weight of the slab if one cubic yard weighs 3700 pounds.

5. Find the volume of a cylinder with a base area of 76 square inches and an altitude of 8.60 inches.

6. Find the volume of a steel shaft which is 59 cm long and has a diameter of 3.84 cm. (Round to hundredths)

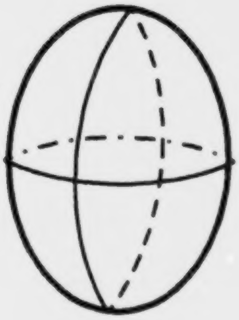
7. A cylindrical hot water heater is 1.8 m high and has a 0.5 m diameter. Compute the volume of the tank to the nearest hundredth.

8. Each of two cylindrical vessels is 15 cm high. The larger vessel has a diameter of 7.8 cm and the smaller has a diameter of 6.12 cm. What is the difference, in cubic centimeters, in the volume of the two cylinders? (Round to hundredths)

9. Each cylinder of a 6-cylinder engine has a 3.21-inch diameter and a piston stroke of 4.68 inches. Find the total piston displacement of the engine to the nearest hundredth.

section IX

money and time



MATHEMATICS FOR THE TECHNOLOGIES

COMPETENCY #63

Compute salaries.

PERFORMANCE OBJECTIVE #84

Given a rate of pay, compute a salary for a given pay period.

INSTRUCTIONAL ACTIVITIES

Sample Item

Susan gets paid $5.60 per hour. With time and a half for all hours over 40, what is Susan's gross pay if she works 45 hrs. one week?

Solution: $266.00

Reg. Pay	Overtime	
$5.60 per hr.	5.60 per hr.(reg)	$224.00 Reg.
x40 hrs.	x1.5 time & a half	+ 42.00 OT
$224.00 reg. pay	$ 8.400	$266.00 gross pay
	x 5 hrs OT	
	$42.00 OT pay	

Notes

Determining salaries is not covered sufficiently in the present text; therefore, these problems have been included to be used as hand-outs and additional application problems.

REFERENCE TO TEXT

None

EVALUATION

1. What is the monthly salary for someone making $14,500 a year?

2. How many pay periods are there in a year for someone paid:

   a) weekly
   b) bi-weekly
   c) semi-monthly
   d) monthly

3. What is the weekly gross pay for someone earning $5.00 an hour for a 38-hour week?

4. What is the annual salary for someone earning $1,430 per month?

ANSWERS TO EVALUATION

1. $1,208.33
2. a) 52
   b) 26
   c) 24
   d) 12
3. $190.00
4. $17,160

ANSWERS TO APPLICATIONS

A.

1. $980.40
2. $634.25
3. a) $331.50
   b) $120.77
   c) $210.73
4. 40 x 8.00 =$ 320.00
   4 1/2 x 12.00 = 54.00
   12 x 16.00 = 192.00
   $ 566.00
5. a) 12 x 7.50 = $ 90.00
   4 x 11.25 = 45.00
   10 x 15.00 = 150.00
   $285.00
   b) 7 1/2 + 8 1/4 + 8 + 5 3/4 + 10 = 39 1/2 hrs.
   39 1/2 x 8.16 = $322.32
6. base pay = $ 500.00
   .03 x 4,000.00 = 120.00
   .035 x 1,660.00 = 58.10
   $678.10
7. .065 x 3,210.00 = $208.65

B.

1. $258.40
2. $1,392.00
3. $13,942.50
4. $393.00
5. a) $1,248.00
   b) $16,224.00
   c) $1,352.00
6. $7.25
7. $225.65
8. $288.79
9. $213.61
10. $336.70
11. a) Total = 516, Gross = $350.88
    b) Total = 432, Gross = $358.56
    c) Total = 359, Gross = $344.64
12. $496.08
13. a) $79.32
    b) $57.60
    c) $62.76
14. $330.00
15. $1,320.00
16. $5,200.00
17. $555.75
18. $1,040.00
19. $1,640.00
20. $1,670.00

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #84

Performance Objective #84: Given a rate of pay, compute a salary for a given pay period.

A. 1. A welder earns $12.90 per hour for the first 40 hours, and time and a half for overtime. How much would a welder make for 64 hours?

2. A machinist earns $8.60 per hour for the first 36 hours, time and a half for the next 14 hours and double time for all hours over 50 or on Sunday. An employee works the following schedule: Monday -- 8 hours 15 minutes; Tuesday -- 8 1/2 hours; Wednesday -- 7 hours 45 minutes; Thursday -- 8 hours; Friday -- 4 hours; Saturday -- 12 hours; and Sunday -- 9 1/2 hours. How much would this employee make for the week?

3. A brick mason who earns $8.50 per hour works 39 hours.
   a) What is the brick mason's gross pay?
   b) Compute the brick mason's total deductions if:
      1) Federal taxes are 20% of gross pay.
      2) State taxes are 5% of gross pay.
      3) Social Security is 6% of gross pay.
      4) Insurance is $18.
   c) What is the brick mason's net pay?

4. A production worker in a large factory is paid $8.00 per hour for up to 40 hours during regular work days and regular work hours. On holidays and Sunday the rate of pay is twice the regular wage. After 40 hours on regular work days, the rate is 1 1/2 the regular wage. How much will the worker earn during a pay period if he/she works 40 regular hours, 4 1/2 hours overtime (regular work days) and 12 hours overtime (holidays and Sunday)?

5. Determine the salaries of workers described in the problems below.

   a) A truck driver at a regular rate of $7.50: 12 regular hours, 4 hours overtime (regular work days), and 10 hours on Sunday.

   b) A factory worker during one week worked the following days. How much will he/she earn at a rate of $8.16 per hour? Monday 7 1/2 hours; Tuesday 8 1/4 hrs; Wednesday 8 hours; Thursday 5 3/4 hours; Friday 10 hours.

6. The Oakdale Company pays their salespersons a salary of $500 a month. In addition, salespersons are paid a commission of 3% on sales up to $4,000 a month and a 3 1/2% commission on sales over $4,000 per month. One salesperson's sales totaled $5,660 for one month. What were that salesperson's earnings for the month?

7. Mrs. Smith sold $3,210 worth of hosiery. She was paid a commission of 6 1/2%. How much did she earn?

B. 1. Karl Charles is paid $6.80 an hour. Last week Karl worked these hours: Monday - 8 hrs.; Tuesday - 8 hrs.; Wednesday - 6 hrs.; Thursday - 8 hrs.; Friday - 8 hrs. What was Karl's total pay for the week?

2. During September, Ken worked 160 regular time hours at $7.25 an hour and 16 overtime hours at $14.50 an hour. What was Ken's gross pay for September?

3. Last year, Sheila worked 2,000 hours at regular time pay and 75 hours at overtime pay. Her regular pay rate was $6.60 an hour and her overtime rate was $9.90 an hour. What was Sheila's gross pay last year?

4. Sally has two jobs. Her full-time job pays $9.00 an hour. A part-time job pays $5.00 an hour. Last week Sally worked 37 hours at her full-time job and 12 hours at her part-time job. Find the total she earned from both jobs.

5. Lamont Greer earns a weekly salary of $312.00. How much would Lamont earn in:
   a) 4 weeks
   b) 52-week year
   c) 1 month

6. Jim Shen worked 42 hours (no overtime) and was paid $304.50 before taxes. What is Jim's pay per hour?

7. For a month, Maria received gross pay of $904.00 from her regular job; $210.00 from an extra job; and tips of $382.45. Her bills/deductions for the month totaled $1,270.80. What amount did Maria have left after she paid her bills?

8. Lenora works on the basis of a 40-hour week at $7.80 an hour with time and a half for overtime. Last week she worked 46 hours. Her deductions totaled $93.41. What was her take-home pay?

9. Danice worked a 40-hour week at $8.00 an hour. Her employer deducted the following: Income tax - $41.75; FICA tax - $22.51; Insurance - $28.35; Union dues - $13.78. What were Danice's net earnings for the week?

10. Larry earned $7.40 an hour and worked 45 1/2 hours (no overtime). What was his gross pay for this week?

11. Find the total pieces and the gross pay for each of these piece rate workers at Lowe, Inc.

	# of Pieces					Total Pieces	Rate Per Piece	Gross Pay
	M	T	W	TH	F			
a) Ekert, W.	102	96	110	108	100		$ 0.68	
b) Fenn, C.	86	92	75	88	91		$ 0.83	
c) Laredo, O.	74	82	80	78	45		$ 0.96	

12. Sue Lyton is paid $.58 1/2 for each frame she finishes. Last week, she finished these frames: Monday - 174; Tuesday - 166; Wednesday - 172; Thursday - 159; Friday - 177. What were her total earnings for the week?

13. The Fenton Gear Company pays the following piece rate:
50 pieces or less - $1.20 each
All pieces over 50 - $1.38 each

What is the gross pay of the following employees?
a) Smith - 64 pieces
b) Johnson - 48 pieces
c) Jones - 52 pieces

14. Francine Hardy is paid on a straight 6% commission basis. If her sales are $5,500.00, how much commission does she earn?

15. Kim Ito is paid a monthly salary of $600.00 and a commission of 3% on all sales. Her total sales for this month are $24,000.00. What is her total monthly income?

16. A real estate agent earns 8% on sales. If he sells a house for $65,000.00 what will his commission be?

17. Robert was paid a commission of 4 1/2% on a sale of $12,350.00. What amount of commission did he earn?

18. Donahue, Inc. pays its salespersons 5% commission on all sales and 3% more commission on all sales over the monthly quota of $8,000.00. In July Gib Clark sold $16,000.00 worth of goods. What was his commission for July?

19. Mary is paid on a salary and commission basis. Her salary is $1,200.00 per month. Her commission is 2% on the first $10,000.00 per month. Last month her sales were $18,000.00. What was her gross pay for the month? (Earns 3% on sales over $10,000.00).

20. Ella Martin is paid a salary of $700.00 a month, and a commission of 3% on all sales over the monthly quota of $7,500.00. In June, her sales were $12,500.00 and in July, $11,500.00. Find her total gross earnings for both June and July.

COMPETENCY #64

Complete invoices.

PERFORMANCE OBJECTIVE #85

Given an invoice form and the necessary rates and prices, complete the invoice to determine a price estimate or exact cost.

INSTRUCTIONAL ACTIVITIES

Sample Item (Not on an invoice)

4 - 3 ft. pipe sections @ $1.25

2 1/2 hrs. labor @ $6.00 per hour

Sales Tax - 5% (not on labor)

Find Total Cost

Solution:

1.25	5.00	6.00
x4	x.05	x.25
5.00 pipe	.25 tax	$15.00 labor
.25		
5.25 pipe + tax		

Total Cost 15.00 + 5.25 = $20.25

Notes

Collect actual invoices for the students to practice completing. Invoices must be completed after each installation or repair is completed. All invoices or bills are approximately the same. If a student can prepare an invoice for equipment, supplies or parts, then this knowledge could be transferred to other areas such as labor, use of equipment, mileage costs, etc.

REFERENCE TO TEXT

None

EVALUATION

Complete the provided invoice with this information.

Customer: White Printing Co.
803 Main Street
New Town, South Carolina 29803
Order No. 604
Today's Date

Qty.	Description	Unit Price
1 ea.	Contactor, 2 Pole, 1200 Coil, FLA 60	$ 81.42
1 ea.	Temperature Control, T4031A, 30° to 50°F, 8 ft. Cap Tube	$ 36.53
2 ea.	Water Regulating Valves, U46AA-1	$ 44.46
2 ea.	Filter Driers, ASF 2556-V	$ 30.06
2 1/2 lbs.	Refrigerant, R-502	$ 3.28
6 1/2 hrs.	Labor for Evacuation	$ 12.85
4 hrs.	Labor for Service and Repair	$ 18.50

ANSWERS TO EVALUATION

pheonix distributors

700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

White Printing Co
803 Main Street
New Town, SC 29803

Date Today's Date
Our Order No. 604
Cust. Order No.
Shipped Via

Terms

Quantity	Description	Unit Price	Total
1 ea.	Contactor, 2 Pole, 1200 Coil, FLA 60	$81.42	$81.42
1 ea.	Temperature Control, T4031A, 30° to 50°F 8 ft. Cap Tube	36.53	36.53
2 ea.	Water Regulating Valves, U46AA-1	44.46	88.92
2 ea.	Filter Driers, ASF 2556-V	30.06	60.12
2.5 lbs.	Refrigerant, R-502	3.28	8.20
6.5 hrs.	Labor for Evacuation	12.85	83.52
4 hrs.	Labor for Service and Repair	18.50	74.00
	TOTAL		$432.71

ANSWER TO APPLICATION No. 1

pheonix distributors

700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

Mr. Ralph Love
209 East Street
New Town, SC 29803

Date Today's Date
Our Order No. 601
Cust. Order No.

Terms

Shipped Via

Quantity	Description	Unit Price	Total
1 ea.	NCH-024AK, Outdoor Unit, S/N Y10163	$608.61	$608.61
1 ea.	NESA-024A0, Indoor Unit, S/N Y9482	149.85	149.85
1 ea.	NEMA-035CF, Electric Heat Strips, S/N H0407323	212.04	212.04
1 ea.	NAXA Thermostat	63.84	63.84
3 ea.	Box, Duct Wrap	43.65	130.95
4 ea.	Tape, 2" Foil	3.63	14.52
2 ea.	Flex Duct, 6", 25 ft.	22.75	45.50
9 ea.	Boot, 4×10×6	1.89	17.01
9 ea.	Side Take Off P62A	2.17	19.53
26 hrs.	Labor	21.75/hr.	565.50
	TOTAL		$1,827.35

ANSWER TO APPLICATION NO. 2

pheonix distributors

700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

Mr. A. J. Phipps
Rt. 6, Box 87
New Town, SC 29803

Date Today's Date
Our Order No. 902
Cust. Order No.
Shipped Via

Terms

Quantity	Description	Unit Price	Total
2 ea.	Tape, Duct	$4.85	$9.70
3 ea.	Staples, Box 9/16	6.75	20.25
2 ea.	"A" Collars, 14"	1.35	2.70
21 ea.	Strap, Thermostat, TL84	.32	6.72
1 ea.	Bramac Pad, 24 × 52	22.06	22.06
11 ea.	Damoper, 6" Malco	.46	5.06
2 ea.	Duct, 18 × 12, 26 ga., 4'	9.02	18.04
6 ea.	Duct, 12 × 8, 26 ga., 4'	8.43	50.58
1 ea.	Transition, 18 × 12 × 12 × 8	5.21	5.21
3 ea.	EK 052 ALCO	6.96	20.88
62 miles	Delivery Charge	.22/mi.	13.64
3 people	Labor - 4 1/2 hrs. each	8.75/hr.	118.12
	TOTAL		$292.96

ANSWER TO APPLICATION NO. 3

pheonix distributors

700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

Arden Micro Sales
20900 City Square
San Jose, CA 95111-6625

Date Today's Date
Our Order No.
Cust. Order No.

Terms

Shipped Via

Quantity	Description	Unit Price	Total
300 ea.	Diskettes	$2.45	$735.00
75 ea.	Printer Ribbons	8.60	645.00
20 ea.	Manifold Forms	26.30	526.00
	SUBTOTAL		1,906.00
	SALES TAX (5%)		95.30
	TOTAL		$2,001.30

ANSWER TO APPLICATION NO. 4

pheonix distributors

700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

Kate's Hardware
337 Lysander Ave.
Berea, OH 44017-3286

Date Today's Date
Our Order No.
Cust. Order No.
Terms
Shipped Via

Quantity	Description	Unit Price	Total
20 ea.	Saw Blades	$6.25	$125.00
120 ea.	Hacksaw Blades	.70	84.00
25 ea.	Tube Cutters	4.80	120.00
	SUBTOTAL		329.00
	SALES TAX (8%)		26.32
	SHIPPING/HANDLING		24.17
	TOTAL		$379.49

ANSWER TO APPLICATION NO. 5

pheonix distributors
700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

John Q. Public
Date Today's Date
Our Order No.
Cust. Order No.
Terms
Shipped Via

Quantity	Description	Unit Price	Total
3	Bottles, Glue	$1.85	$5.55
24	Clamps	1.75 for 3	14.00
1	Battery	.69 for 3	.30
32	Pounds, Brads	.875	28.00
4	Rolls, Tape	2.89	11.56
1	Dozen, Rollers	12.42/doz.	12.42
1/2	Dozen, Washers	1.50/doz.	.75
	SUBTOTAL		72.58
	SALES TAX (5%)		3.63
	TOTAL		$76.21

ANSWER TO APPLICATION NO. 6

Estimation for painting Mr. Jordan's living room.

	Description	Unit Price	Total
a)	4 gals. paint for walls - 2 coats	$15.00	$60.00
b)	1 1/2 gals. paint for ceiling - 2 coats	10.00	15.00
c)	1 gal. paint for molding - 2 coats	20.00	20.00
d)	1 roller with handle	11.00	11.00
e)	1 - 4" brush	15.00	15.00
f)	1 - 3" brush	10.00	10.00
g)	1 - 2" brush	8.00	8.00
	SUBTOTAL OF SUPPLIES		$139.00
h)	Labor - 2000 sq. ft./wall & ceiling		480.00
i)	Labor - 2 doors @ $10.00		20.00
j)	Labor - 2 windows @ $15.00		30.00
	SUBTOTAL OF LABOR		530.00
	SALES TAX (5%) SUPPLIES		6.95
	TOTAL ESTIMATE		$675.95

ANSWER TO APPLICATION NO. 7

pheonix distributors

700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

Mr. Newton

Date Todays Date

Our Order No.

Cust. Order No.

Terms

Shipped Via

Quantity	Description	Unit Price	Total
12 ea.	2" × 8' × 10" Treated Lumber	$5.69	$68.28
12 ea.	5/4" × 56" × 12" Treated Lumber	3.44	41.28
80 ea.	2" × 2" × 40" Treated Lumber	.90	72.00
3 ea.	2" × 6" × 16' Treated Lumber	5.25	15.75
4 ea.	4" × 4" × 8' Treated Lumber	8.69	34.76
10 lbs.	8-sided nails	6.00/5 lbs.	12.00
4 bags	Concrete	3.89	15.56
15 lbs.	#16 EG Nails		7.40
	SUBTOTAL		267.03
	SALES TAX (5%)		13.35
8 hrs.	Labor	30.00/hr.	240.00
			$520.38
	TOTAL		

436

ANSWER TO APPLICATION NO. 8

pheonix distributors
700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963

Invoice

Mr. Stewart

Date
Our Order No.
Cust. Order No.
Terms
Shipped Via

Quantity	Description	Unit Price	Total
1 ea.	100 Amp. 4 Breaker Box	$85.00	$85.00
1 ea.	30 Amp. Double Pole Breaker	13.00	13.00
1 ea.	15 Amp. Single Pole GFI Breaker	23.00	23.00
1 ea.	20 Amp. Double Pole GFI Breaker	54.00	54.00
30 ft.	10/2 W/G Underground	1.40/ft.	42.00
10 ft.	12/2 WG	.78/ft.	7.80
6	1/2" Connectors	.67	4.02
	SUBTOTAL		228.82
	SALES TAX (5%)		11.44
4.5 hrs.	Labor	35.00/hr.	157.50
	TOTAL		$397.76

APPLICATIONS
FOR
PERFORMANCE OBJECTIVE #85

Performance Objective #85: Given an invoice form and the necessary rate and prices, complete the invoice to determine a price estimate or exact cost.

Using the blank invoice from Phoenix Distributors, prepare invoices for the following jobs.

1. Customer:
Mr. Ralph Love
209 East Street
New Town, South Carolina 29803
Order No. 601
Today's Date

Qty.	Description	Unit Cost
1 ea.	NCH-024AK, Outdoor Unit, S/N Y10163	$ 608.61
1 ea.	NESA-024AO, Indoor Unit, S/N Y9482	$ 149.85
1 ea.	NMEA-035CF, Electric Heat Strips S/N H0407323	$ 212.04
1 ea.	NAXA Thermostat	$ 63.84
3 ea.	Box, Duct Wrap	$ 43.65
4 ea.	Tape, 2" Foil	$ 3.63
2 ea.	Flex Duct, 6", 25 ft.	$ 22.75
9 ea.	Boot, 4 x 10 x 6	$ 1.89
9 ea.	Side Take Off P62A	$ 2.17

26 hrs.--Labor @ $21.75 per hr.

2. Customer:
Mr. A. J. Phipps
Rt. 6, Box 87
New Town, South Carolina 29803
Order No. 902
Today's Date

Qty.	Description	Unit Price
2 ea.	Tape Duct	$ 4.85
3 ea.	Staples, Box 9/16	$ 6.75
2 ea.	"A" Collars, 14"	$ 1.35
21 ea.	Strap, Thermostrap, TL84	$ 0.32
1 ea.	Bramac Pad, 24 x 52	$ 22.06
11 ea.	Damper, 6" Malco	$ 0.46
2 ea.	Duct, 18 x 12, 26 ga., 4'	$ 9.02
6 ea.	Duct, 12 x 8, 26 ga., 4'	$ 8.43
1 ea.	Transition, 18 x 12 to 12 x 8	$ 5.21
3 ea.	EK 052 ALCO	$ 6.96

Delivery charge -- 62 miles at $0.22 per mile
Labor--3 service persons--4 1/2 hrs. each at $8.75 per hr.

3. Customer:

Arden Micro Sales
20900 City Square
San Jose, CA 95110-6625

Qty.	Description	Unit Cost
300	Diskettes	$ 2.45
75	Printer Ribbons	$ 8.60
20	Manifold Forms	$ 26.30
	Sales Tax at 5%	
	Total	?

4. Customer:

Kate's Hardware
337 Lysander Ave.
Berea, OH 44017-3286

Qty.	Description	Unit Cost
20	Saw Blades	$ 6.25
120	Hacksaw Blades	$ .70
25	Tube Cutters	$ 4.80
	Sales Tax at 8%	
	Shipping/Handling	$ 24.17
	Total	?

5. Customer: John Q. Public

Qty.	Description	Total
3	Bottles, glue @ $1.85	
24	Clamps @ 3 for $1.75	
1	Battery @ 3 for 89c/	
32	Pounds, Brads @ 87 1/2/lb.	
4	Rolls, Tape @ $2.89	
1	Dozen Rollers, $12.42/doz.	
1/2	Dozen Washers @ $1.50/doz.	
	Sales Tax at 5%	
	Total	?

6. *Mr. Jordan wants to have his living room painted. Write an estimate for the job, showing all special charges and all supplies needed. The room is 15' x 20' with 10' ceilings. The job will need two coats of paint.

* Do not use an invoice for this problem.
a) Wall space = 700 sq. ft. 4 gallons/paint @ $15.00
b) Ceiling space = 300 sq. ft. 1 1/2 gallons/paint @ $10.00
c) Base Molding = 64 ft. + Crown Molding = 70 ft. =
1 gallon/paint @ $20.00
d) 1-Roller with handle $11.00
e) 1-4" Brush $15.00
f) 1-3" Brush $10.00
g) 1-2" Brush $ 8.00

(Continued on next page)

(Problem No. 6 Continued)

h) Labor = $ .24 per sq. ft./wall & ceiling space
i) Labor = 2 Doors @ $10.00 ea.
j) Labor = 2 Windows @ $15.00 ea.
k) Subtotal of supplies
l) Sales Tax (5%) (Supplies only)
m) Total labor
n) Total estimate

7. John is going to add an 8' x 12' deck on Mr. Newton's house. Using included invoice form, find the cost of this deck.

QTY.	Description
12	2" x 8' x 10' treated lumber @ $5.69
12	5/4" x 6" x 12' treated lumber @ $3.44
80	2" x 2" x 40" treated lumber @ $.90
3	2" x 6" x 16' treated lumber @ $5.25
4	4" x 4" x 8' treated lumber @ $8.69
10 lbs.	8-sided nails @ $6.00 for 5 lbs.
4 bags	Concrete @ $3.89
15 lbs.	#16 EG nails, $7.40
	Sales Tax (5%)
8 hrs.	Labor @ $30.00 per hour

8. Mr. Stewart had John Sharpe install the wiring for a new Hot Tub. Fill in an invoice with total costs. (Not buying the Tub Unit.)

Qty.	Description		Unit Cost
1	100 Amp. 4 Breaker Box		$ 85.00
1	30 Amp. Double Pole Breaker		$ 13.00
1	15 Amp. Single Pole GFI Breaker		$ 23.00
1	20 Amp Double Pole GFI Breaker		$ 54.00
30'	10/2 W/G Underground	@	$ 1.40
10'	12/2 W/G	@	$ .78
6	1/2" Connectors	@	$ .67
	Subtotal		
	Sales Tax (5%)		
4 1/2 hrs.	Labor	@	$ 35.00 per hr.
	Total		

MASTER COPY OF INVOICE

pheonix distributors

700 East San Juan Avenue Pheonix, AZ 8510 (602) 774-3963 *Invoice*

Date

Our Order No.

Cust. Order No.

Terms Shipped Via

Quantity	Description	Unit Price	Total

441